ESSAYS

Of the

Strange Subtilty
Determinate Nature } of EFFLUVIUMS.
Great Efficacy

To which are annext

New Experiments to make *FIRE* and *FLAME* Ponderable.

Together with

A Diſcovery of the Perviouſneſs of *Glaſs*.

ALSO

An *ESSAY*, about the Origine and Virtue of *GEMS*.

By the Honorable ROBERT BOYLE, *Fellow of the* Royal Society.

To which is added

The *PRODROMUS* to a Diſſertation concerning *Solids* naturally contained within *Solids* Giving an Account of the *Earth*, and its Productions.

By *Nicholas Steno*. Engliſhed by *H. O.*

London, Printed by *W. G.* for *M. Pitt*, at the *Angel* near the little North Door of St *Paul*'s Church. 1673.

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BIBLIOTHECA · BODLEIANA

An Advertiſement to the READER.

THIS hop'd, the Reader will not think it ſtrange, not to meet with in the following Papers a more cloſe and uniform contexture of the paſſages that make them up, if he be ſeaſonably inform'd of the riſe and occaſion of penning them, which was this. The Author having many years ago written an Eſſay about an Experiment he made of Nitre, by whoſe Phænomena he endeavour'd to exemplifie ſome parts of the Corpuſcular Philoſophy, eſpecially the Production of Qualities; he afterwards threw together divers occurring thoughts and experiments, which he ſuppos'd might be imployed by way of Notes, to prove or illuſtrate thoſe Doctrines, and eſpecially thoſe that concern'd the Qualities of Bodies; and among theſe

obſerving thoſe that are cali'd Occult, *to be Subjects uncultivated enough, (at leaſt in the way that ſeem'd to him proper,) he propos'd to handle them more largely than moſt of the reſt; and in order to that Deſign he judg'd it almoſt neceſſary, to premiſe ſome Conſiderations and experimental Collections* about *the Nature and power of Effluviums*, about *the Pores of Bodies and Figures of Corpuſcles*, *and* about *the efficacy of ſuch Local-motions as are wont either to be judged very faint, or to be paſs'd by unheeded. For he had often look'd upon theſe three Doctrines, of* Effluvia, *of* Pores *and* Figures, *and of* Unheeded Motions, *as the three principal Keys to the Philoſophy of Occult Qualities. But having hereupon made ſuch Collections, as upon review appear'd too large to paſs for Notes on ſo ſhort a Text, he was induc'd to draw them * into the form (they now appear in) of* Eſſays; *but he would not put himſelf to the trouble of doing it, with care to keep them*

* And ſome that were publiſh'd *An.* 1669. under the Title of *The Atmoſpheres of conſiſtent Bodies.*

them from retaiaing much of their first want of exact Method and Connexion. Nor was the Author solicitous to finish them up, in regard that his other Studies and occasions made him perceive, that in what he had design'd about Occult Qualities, he had cut himself out more work than probably he should during many years have opportunity to set upon in earnest, and complete. And in this Condition these Papers lay for divers years, (as is well known to several that saw them, or even transcrib'd some of them,) and might have continued to do so, if the Author had not been induc'd to let them come abroad, partly *by considering, that though the Subjects, (however he handled them) were as well important as curious; yet he did not find himself prevented by others in what he had to publish about them;* and partly *by the References he had made to them in some other Papers, that he had promised his Friends, wherein several things here deliver'd are vouched, and others suppos'd. And because the Notes concerning the Porosity of greater Bodies and the*

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Figurations of minute Particles, together with the Paper about unregarded Motions, having been long laid aſide among other neglected papers, were ſome of them miſſing, and others ſo mis-us'd, that they could not eaſily be made ready to accompany thoſe that now come abroad; the Author, that he might keep this Book from having its dimenſions too diſproportionate, was content to add to the thickneſs of it, by ſubjoyning one of thoſe little Tracts, that lay by him, concerning Flame, *becauſe of the Affinity betwixt the preceding Doctrine about* Effluviums *in general, and Experiments that ſhew in particular the Subtilty and the Efficacy of thoſe of Fire and Flame. And though, to that Tract it ſelf, there belong another, deſign'd to examine, Whether the matter of what we call the* Sun-beams, *may be brought to be ponderable; yet ſuppoſing this, hitherto cold and wet Summer, to be like to be as unfriendly to the Tryals to be made with Burning-glaſſes as of late years ſome other Summers have prov'd, he was eaſily prevail'd with, not to make thoſe Experiments*

ments that were ready, wait any longer for those, that probably will not in a short time be so; especially since those that now come abroad have no dependency upon the others.

OF

OF THE
Strange SUBTILTY
OF
EFFLUVIUMS.

BY

The Honorable ROBERT BOYLE.

LONDON:

Printed by *W. G.* for *M. Pitt* at the ſign of the White Hart, over-againſt the little North Door of St *Paul*'s Church. 1673.

OF

The ſtrange SUBTILTY

OF

EFFLUVIUMS.

CHAP. I.

WHether we ſuppoſe with the Antient and Modern *Atomiſts*, that all ſenſible Bodies are made up of Corpuſcles, not only inſenſible, but indiviſible; or whether we think with the *Carteſians*, and (as many of that Party teach us) with *Ariſtotle*, that Matter, like Quantity, is indefinitely, if not infinitely diviſible: It will be conſonant enough

to either Doctrine, that the *Effluvia* of Bodies may conſiſt of Particles *extremely ſmall*. For if we embrace the Opinion of *Ariſtotle* or *Des-Cartes*, there is no ſtop to be put to the ſubdiviſion of Matter, into Fragments, ſtill leſſer and leſſer. And though the *Epicurean* Hypotheſis admit not of ſuch an *interminate* diviſion of Matter, but will have it ſtop at certain ſolid Corpuſcles, which for their not being further diviſible are called *Atoms* (Ἄτομοι;) yet the Aſſertors of theſe do juſtly think themſelves injured, when they are charged with taking the *Motes* or ſmall Duſt, that fly up and down in the Sun-Beams, for their Atoms; ſince, according to theſe Philoſophers, one of thoſe little grains of Duſt, that is viſible only when it plays in the Sun-Beams, may be compoſed of a multitude of Atoms, and exceed many thouſands of them in Bulk. This the Learned *Gaſſendus* in his Notes on *Diogenes Laertius* makes probable by the inſtance of a ſmall Mite, which, though ſcarce diſtinctly

distinctly discernable by the naked Eye, unless when 'tis in motion, does yet in a good Microscope appear to be a compleat Animal, furnished with all necessary Parts; which I can easily allow, having often in Cheese-Mites very distinctly seen the Hair growing upon their Legs. And to the former Instance I might add, what I have elsewhere told you of a sort of Animals far lesser than Cheese-Mites themselves, namely those that may be often-times seen in Vinegar. But what has been already said may suffice for my present purpose, which is only to shew, that the wonderful minuteness I shall hereafter ascribe to *Effluvia*, is not inconsistent with the most received Theories of Naturalists. For otherwise in this Essay the Proofs I mean to employ, must be taken, not *à Priori*, but *à Posteriori*. And the Experiments and Observations I shall employ on this occasion will be chiefly those, that are referrible to one of the following Heads.

I. *The ſtrange Extenſibility of ſome Bodies whilſt their Parts yet remain tangible.*

II. *The multitude of Viſible Corpuſcles, that may be afforded by a ſmall portion of Matter.*

III. *The ſmallneſs of the Pores at which the* Effluvia *of ſome Bodies will get in.*

IV. *The ſmall decrement of Bulk or Weight, that a Body may ſuffer by parting with great ſtore of* Effluvia.

V. *The great quantity of Space that may be fill'd, as to ſenſe, by a ſmall quantity of Matter when rarified or diſpers'd.*

But though to theſe diſtinct Heads I ſhall deſign diſtinct *Chapters*, yet you muſt not expect to find the Inſtances ſolicitouſly marſhall'd, but ſet down in the order they occurr'd to me; ſuch a liberty being allowable

This Eſſay was deſigned to be but a part of the Author's Notes upon his Eſſay about Salt-peter.

allowable in a Paper, where I pretend not to write *Treatiſes*, but *Notes*.

CHAP. II.

AMong many things that are groſs enough to be the Objects of our Touch, and to be managed with our Hands, there are ſome that may help us to conceive a wonderful minuteneſs in the ſmall Parts they conſiſt of.

I do not remember what *Cardan*, and ſince him another Writer have deliver'd about the Thinneſs and Slenderneſs to which Gold may be brought. And therefore without poſitively aſſenting to, or abſolutely rejecting what may have been ſaid about it by others, I ſhall only borrow on this occaſion, what I have mention'd on another *In a Paper about Improbable Truths*, upon my own Obſervation; namely,

That Silver, whose Ductility and Tractility are very much inferiour to those of Gold, was, by my procuring, drawn out to so slender a Wire, that, when we measur'd it, which was somewhat troublesom to do, with a long and accurate measure, we found, that eight Yards of it did not yet fully counterpoise one Grain: So that we might add a Grain more without making the Scale, wherein 'twas put, manifestly preponderate, notwithstanding the Tenderness of the Ballance. Whence we concluded, that a single Grain of this Wire amounted to 27 Foot, that is, 324 Inches. And since Experience informs us, that half an *English* Inch can by Diagonal Lines be divided into 100 parts great enough to be easily distinguish'd, even for Mechanical uses, it follows, that a Grain of this wire-drawn Silver may be divided into 64800 parts, and yet each of these will be a true metalline, though but slender and short, Cylinder, which we may very well conceive to consist

yet

yet of a multitude of minuter parts. For though I could procure no Gilt Wire near ſo ſlender as our newly mention'd Silver-wire; yet I tryed that ſome which I had by me was ſmall enough to make one Grain of it fourteen foot long: At which rate an Ounce did amount to a full Mile, conſiſting of 1000 Geometrical Paces, (of 5 foot a-piece,) and 720 foot over and above. And if now it be permitted to ſuppoſe the Wire to have been, as in probability it might have been, further drawn out to the ſame ſlenderneſs with the above-mention'd Silver-wire, the Inſtance will ſtill be far more conſiderable; for in this caſe, each of thoſe little Cylinders, of which 64800 go to the making of one Grain, will have a ſuperficial *Area*, which, except at the *Baſis*, will be cover'd with a Caſe of Gold; which is not only ſeparable from it by a mental Operation, but perhaps alſo by a Chymical one. For I remember, that from very ſlender gilt Wire, though I could get none

none ſo ſlender as this of meer Silver, I did more than once, for Curioſities ſake, ſo get out the Silver, that the golden Films, whilſt they were in a Liquor that plumpt them up, ſeem'd to be ſolid wires of Gold: But when the Liquor was withdrawn, they appear'd, (as indeed they were) to be oblong and extremely thin and double Membranes of that Metal, which, with an Inſtrument that had been delicate enough, might have been ripp'd open, and diſplayed, and been made capable of further Diviſions and Subdiviſions. To this I ſhall add, that each of the little ſilver Cylinders I lately ſpake of, muſt not only have its little *Area*, but its Solidity; and yet I ſaw no reaſon to doubt, but that it might be very poſſible, if the Artificer had been ſo skilful and willing as I wiſh'd, to have drawn the ſame quantity of Metal to a much greater length, ſince even an Animal ſubſtance is capable of being brought to a ſlenderneſs much ſurpaſſing that of our Wire, ſuppoſing the Truth of

of an Obſervation of very credible Perſons critical enough in making Experiments, which, for a Confirmation and an Improvement of our preſent Argument, I ſhall now ſubjoyn. An Ingenious Gentlewoman of my Acquaintance, Wife to a Learned Phyſician, taking much pleaſure to keep Silk-worms, had once the Curioſity to draw out one of the Oval Caſes, (which the Silk-worm ſpins, not, as 'tis commonly thought, out of its Belly, but out of the Mouth, whence I have taken pleaſure to draw it out with my Fingers,) into all the Silken-wire it was made up of, which, to the great wonder as well of her Husband, as her ſelf, who both inform'd me of it, appeared to be by meaſure a great deal above 300 Yards, and yet weigh'd but two Grains and a half: ſo that each Cylindrically ſhap'd Grain of Silk may well be reckon'd to be at leaſt 120 Yards long.

Another way, I remember, I alſo employed to help men by the extenſibility of Gold the better to conceive the

the Minuteness of the Parts of Solid Bodies.

We took six beaten Leaves of Gold, which we measured one by one with a Ruler purposely made for nice Experiments, and found them to have a greater equality in Dimensions, and to be nearer true Squares, than could be well expected: The side of the Square was in each of them exactly enough three Inches and $\frac{3}{8}$, (or $\frac{1}{4}$,) which number being reduc'd to a Decimal Fraction, *viz.* $\frac{3125}{1000}$, and multiplied by it self, affords $\frac{10|15625}{10000}$ for the *Area*, or superficial Content of each square Leaf: And this multiplied by 6, the number of the Leaves, amounts to $\frac{63|93750}{10000}$ square Inches, for the *Area* of the six Leaves. These being carefully weigh'd in a pair of tender Scales, amounted all of them to one Grain and a quarter: And so one Grain of this foliated Gold was extended to somewhat above fifty Inches; which differ'd but about a fifth part from an Experiment of the like nature, that I remember I made many

many years ago in a pair of exact Scales; and ſo ſmall a difference may very well be imputed to that of the pains and diligence of the Gold-Beaters, who do not always work with equal ſtrength and skill, nor upon equally fine and ductile Gold.

Now if we recal to mind what I was lately ſaying of the actual diviſibility of an Inch into an hundred ſenſible parts, and ſuppoſe an Inch ſo divided to be applied to each ſide of a ſquare Inch of the Leaf-Gold newly mention'd, 'tis manifeſt that by ſubtle parallel Lines, drawn between all the oppoſite Points, a Grain of Gold muſt be diviſible into five hundred thouſand little Squares, very minute indeed, but yet diſcernible by a ſufficiently ſharp-ſighted Eye. And if we ſuppoſe an Inch to be divided into two hundred parts, as I lately told you it was in a Ruler I employ, then, according to the newly recited way, the number of the Squares, into which a ſingle Grain is capable of being divided, will amount to no leſs than two Millions. There

There is yet another way that I took to ſhew, that the extenſibility, and conſequently the diviſibleneſs of Gold is probably far more wonderful, than by the lately mention'd Tryal it appears.

For this purpoſe I went to a great Refiner, whom I uſed to deal with for purify'd Gold and Silver, and inquir'd of him, how many Grains of Leaf-Gold he was wont to allow to an Ounce of Silver, when it was to be drawn into gilt Wire as ſlender as an Hair? To this he anſwer'd me, that eight Grains was the proportion he allowed to an Ounce when the Wire was to be well gilt; but if it were to be more ſlightly gilt, ſix Grains would ſerve the turn. And to the ſame purpoſe I was anſwer'd by a skilful Wire-drawer. And I remember, that deſiring the Refiner to ſhew me an Ingot of Silver, as he did at firſt gild it; he ſhew'd me a good fair Cylindrical Bar, whereon the Leaf-Gold, that overlaid the ſurface, did not appear to be by odds

odds ſo thick as fine *Venetian* Paper; and yet comparing this with gilt Wire, which I alſo deſired to ſee, the Wire appeared to be the better gilt of the two; poſſibly becauſe the Gold in paſſing through the various Holes, was by the ſides of them not only extended but poliſhed, which made it look more vividly than the unpoliſh'd Leaves that gilded the Ingot.

So that, if we ſuppoſe an Ounce of the gilt Wire formerly mention'd to have been gilt with ſix Grains of Leaf-Gold, it will appear by an eaſie calculation, that at this rate one Ounce of Gold, employ'd on gilding Wire of that ſlenderneſs, would reach between ninety and an hundred Miles. But if now we further ſuppoſe, as we lately did, that the ſlender Silver-wire, mention'd at the beginning of this Chapter, were gilt; though we ſhould allow it to have (becauſe of its exceeding ſlenderneſs,) not, (as the former) 6 Grains, but 8 Grains of Leaf-Gold to an Ounce of Siver,

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it muſt be acknowledged, that an hollow Cylinder or ſheath of Gold weighing but eight Grains, may be ſo ſtretch'd, that 'twill reach to no leſs than 60 times as much (in weight) of Silver-wire as it covers: [I ſaid 60 times, for ſo often is 8 contain'd in 480, the number of Grains in an Ounce;] and conſequently (a Grain of *that* Wire having been found to be 27 foot long,) the Ounce of Gold would reach to ſeven hundred ſeventy ſeven thouſand ſix hundred foot, that is, an hundred fifty five Miles and above a half. And if we yet further ſuppoſe this ſuperficial or hollow Cylinder of Gold to be ſlit all along, and cut into as ſlender liſts or thongs as may be, we muſt not deny that Gold may be made to reach to a ſtupendious length. But we need not this laſt ſuppoſition to make what preceded it an amazing thing: which yet though it be indeed Stupendious and *ſeem* Incredible, ought not at all to be *judg'd* Impoſſible; being no more than what upon the Suppo-

Suppoſitions and Obſervations above laid down, does evidently follow.

CHAP. III.

AFter what has been ſaid of the minuteneſs of *tangible* Objects, 'twill be proper to ſubjoyn ſome inſtances of the ſmallneſs of ſuch as yet continue *viſible*. But in regard theſe Corpuſcles are ſingly too little to have any common meaſure apply'd to any of them, we muſt make an eſtimate of their minuteneſs by the number of thoſe into which a ſmall portion or fragment of matter may be actually divided, the multitude of theſe being afforded by ſo inconſiderable a Quantity of matter, ſufficiently declaring, that each of them, in particular, muſt be marvelouſly little.

Among the inſtances, where the ſmallneſs of Bodies may be deduc'd from what is immediately the Object of Sight, it may not be unfit to take

notice of the evaporation of Water, which though it be granted to conſiſt of groſs particles in compariſon of the ſpirituous and odoriferous ones of divers other Liquors, as of pure Spirit of Wine, Eſſential Oyls of Spices, *&c.* yet to ſhew that a ſmall Quantity of it may be diſpers'd into a multitude of manifeſtly viſible Corpuſcles, I thought upon, and more than once try'd, the rarefaction of it into Vapors by help of an *Æolipile*, wherein, when I made the Experiment the laſt time, I took the pains to regiſter the Event as follows.

We put an Ounce of common Water into an *Æolipile*, and having put it upon a Chafing-diſh of coals, we obſerv'd the time when the ſtreams of Vapors began to be manifeſt. This ſtream was for a good while impetuous enough, as appear'd by the noiſe it made, which would be much increaſed, if we applied to it at a convenient diſtance a kindled brand, in which it would blow up the

the fire very vehemently. The ſtream continued about a quarter of an hour (ſixteen minutes or better,) but afterwards the Wind had pauſes and guſts for two or three minutes before it quite ceaſed. And by reaſon of the ſhape of the *Æolipile*, (which being fram'd chiefly for other purpoſes, was not ſo convenient for this) a great portion of the Vapors condens'd in the upper part of it, and fell down in drops; ſo that ſuppoſing that they alſo had come out in the form of Wind, and the blaſt had not been intermitted toward the latter end, I gueſs'd it might have continued uninterruptedly 18 or 20 minutes. *Note*, That applying a meaſure to the Smoak, that came out very viſible in a form almoſt conical, where it ſeem'd to have an Inch or more in Diameter; 'twas diſtant from the hole of the *Æolipile* about twenty Inches; and five or ſix Inches beyond that, though it were ſpread ſo much, as to have four or five Inches in Diameter, yet the not uniform

but ſtill-cohering Clouds (which was the form wherein the Vapors appear'd) were manifeſt and conſpicuous.

After the rarefaction of Water when 'tis turn'd into Vapors, we may conſider *that* of Fewel when 'tis turn'd into Flame; to which purpoſe I might here propoſe ſeveral Tryals as well of our own as others, about the prodigious Expanſion of ſome Inflammable Bodies upon their being actually turn'd into Flame. But in this place to mention all theſe, would perhaps too much intrench upon another Paper; and therefore I ſhall here propoſe to your conſideration but one inſtance, and that very eaſie to be tryed; of which I find this account among my *Adverſaria.*

Having oftentimes burnt Spirit of Wine, and alſo Oyl in Glaſs-lamps, that for certain uſes were ſo made, that the ſurface of the Liquor was ſtill circular, 'twas obvious to obſerve, how little the Liquor would

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ſubſide by the waſt that was made of it, in about half a quarter of an hour. And yet if we conſider, that the naked Eye after ſome Exerciſe, may, as I have often tryed, diſcern the motions of a *Pendulum* that ſwings faſt enough to divide a ſingle minute of an hour into 240 parts, and conſequently half a quarter of an hour into 1800 parts; if we alſo conſider into how many parts of the time imployed by a *Pendulum*, the Vibrations, ſlow enough to be diſcernible by the Eye, may be mentally ſubdivided; and if we further conſider, that without intermiſſion, the Oyl is preyed upon by an actual Flame, and the particles of it do continually furniſh a conſiderable ſtream of ſhining matter, that with a ſtrange celerity is always flying away; we may very well conceive, that thoſe parts of Flame into which the Oyl is turned, are ſtupendiouſly minute, ſince, though the waſting of the Oyl is in its progreſs too ſlow to be perceived by the Eye, yet 'tis

undoubted that there is a continual decrement of the depth of the Oyl, the Phyſical ſurfaces whereof are continually and ſucceſſively attenuated and turn'd into flame; and the ſtrange ſubtilty of the Corpuſcles of flame would be much the ſtronglier argued, if we ſhould ſuppoſe, that inſtead of common Oyl the flame were nouriſh'd by a fewel ſo much more compact and durable, as is that inflammable ſubſtance made of a Metalline Body, of whoſe laſtingneſs I have elſewhere made particular mention, after having taught the way of preparing it.

In ſome Papers about Flame.

Having in a pair of tender Scales carefully weigh'd out half a Grain of good Gunpowder, we laid it on a piece of Tile, and whelm'd over it a veſſel of glaſs (elſewhere deſcrib'd, and often mention'd) with a Braſs-plate to cover the upper orifice of it. Then having fir'd the Gunpowder, we obſerv'd that the ſmoak of it did opacate, and as to ſenſe ſo fill the whole

whole cavity of the Glaſs, though its *Baſis* were eight inches, its perpendicular height above twenty inches, and its figure far more capacious than if it were conical; and this ſmoak, not containing it ſelf within the veſſel, iſſued out at two or three little intervals, that were purpoſely left between the orifice of the veſſel and the plate that lay upon it. This cover we then remov'd, that we might obſerve how long the ſmoak would continue to aſcend; which we found it would do for about half a quarter of an hour, and during near half that time, (*viz.* the three firſt minutes) the continually aſcending ſmoak ſeem'd to be, at its going out, of the ſame Diameter with the orifice at which it iſſu'd; and it would aſcend ſometimes a foot, ſometimes half a yard, ſometimes two foot or more into the Air, before it would diſperſe and vaniſh into it.

Now if we conſider, that the cavity of this round Orifice was two inches in Diameter, how many myr-

riads of viſible Corpuſcles may we eaſily conceive throng'd out at ſo large an out-let in the time above-mention'd, ſince they were continually thruſting one another forwards? And into ſo many viſible Particles of ſmoak muſt we admit, that the half Grain of Powder was ſhatter'd, beſide thoſe multitudes, which, having been turn'd into actual flame, may probably be ſuppos'd to have ſuffer'd a comminution, that made them become inviſible. And though I ſhall not attempt ſo hopeleſs a work, as to compute the number of theſe ſmall Particles, yet to make an eſtimate whereby it would appear to be exceeding great, I thought fit to conſider, how great the Proportion was between the ſpaces, that to the Eye appear'd all full of ſmoak, and the dimenſions of the Powder that was reſolv'd into that ſmoak. Cauſing then the Glaſs to be fill'd with common Water, we found it to contain above two and twenty Pints of that liquor, and cauſing one of thoſe meaſures

meaſures to be weigh'd, it was found to weigh ſo near a pound (of ſixteen ounces,) that the computation of the whole Water amounted to at leaſt 160000 grains, and conſequently 320000 half grains. To which if we add, that this Gunpowder would readily ſink to the bottom of Water, as being (by reaſon of the Saltpeter and Brimſtone, that make up at leaſt ſix parts of ſeven of it) *in ſpecie* heavier than it, and in likelyhood twice as heavy, (for 'tis not eaſie to determine it exactly,) we may probably gueſs the ſpace to which the ſmoak reach'd to exceed 500000 times that, which contain'd the unfir'd Powder; and this, though the ſmoak, being confin'd in the veſſel, was thereby kept from diffuſing it ſelf ſo far as by its ſtreaming out it ſeem'd likely that it would have done.

To theſe Inſtances from Inanimate Bodies I ſhall ſubjoyn one more taken from Animals. Whereas then men have with Reaſon wonder'd, that ſo ſmall a Body as a Cheeſe-mite,

which

which by the naked Eye is oftentimes not to be taken notice of, unleſs it move, (if even then it be ſo,) ſhould by the Microſcope appear to be an Animal furniſh'd with all neceſſary parts; whereas this, I ſay, has given juſt occaſion to conclude, that the Corpuſcles that make up the parts of ſo ſmall an Animal, muſt themſelves be extremely ſmall; I think the Argument may be much improved by the following Conſideration. Thoſe that have had the Curioſity to open from time to time Eggs that are ſat upon by a hatching Hen cannot but have obſerved, how ſmall a proportion in reference to the bulk of the whole Egg the Chick bears; when that, which the Excellent *Harvey* calls *Punctum ſaliens*, diſcloſes the motion of the Heart, and the colour of the Blood; and that even about the ſeventh or eighth day the whole Chick now viſibly form'd, bears no great proportion to the whole Egg, which is to ſupply it with Aliment, not only for its nouriſhment,

ment, but ſpeedy growth for many days after.

To apply this now to the matter in hand, having ſeveral times obſerved and ſhewn to others, that Cheeſe-mites themſelves are generated of Eggs, if we conceive, that in theſe Eggs, as in ordinary ones, the Animal at its firſt formation bears but a ſmall proportion to the bulk of the whole Egg, the remaining part being to ſuffice for the food and growth of the *Embryo* probably for a pretty while; ſince, if an Ingenious perſon, that I deſired to watch them, did not mis-inform me, they uſed to be about ten or twelve days in hatching; this whole Egg it ſelf will be allowed to be but little in reference to the Mite it came from, how extremely and unimaginably minute may we ſuppoſe thoſe parts to be, that make up the Alimental Liquors, and even the Spirits, that paſſing through the Nerves or Analogous parts, ſerve to move the Limbs and Senſories of but, as it were, the

the Model of ſuch an Animal, as, when it reſts, would not (perhaps) it ſelf to the naked Eye be ſo much as viſible; and in which we may preſume the nobler ſort of ſtabler parts to be of an amazing ſlenderneſs, if we conſider, that, though in other hairy Animals, the Optick or ſome other of the larger Nerves do, I know not how many times, in thickneſs and circuit ſurpaſs a hair of the ſame Animal; yet in a Cheeſe-Mite, though none of the largeſt of thoſe Creatures, we have divers times manifeſtly ſeen, as is before intimated, ſingle Hairs that grow upon the Legs.

Another way there is, that I imployed to give men cauſe to think, that the inviſible *Effluvia* of Bodies that wander through the Air may be ſtrangely minute; and this was, by ſhewing how ſmall a fragment of matter may be reſolved into particles minute enough to aſſociate themſelves in ſuch numbers with a Fluid ſo much more denſe than Air, as Water

Water is, as to impart a determinate Colour to the whole liquor. What I did with *Cocheneel* in profecution of this deſign, my Experiments about *Colours* may inform you; but I ſhall now relate the ſucceſs of an attempt made another way, for which perhaps ſome of your friends the Chymiſts will thank me; though I was not ſolicitous to carry on the Experiment very far with Gold, not becauſe I judged that leſs diviſible into a number of colour'd particles, but becauſe I found, as I expected, that the paleneſs of the native colour of the Gold may make it in the end leſs conſpicuous, though, if I had then had by me a *Menſtruum*, as I ſometimes had, that would diſſolve Gold blood-red, perhaps the experiment with Gold would have ſurpaſs'd that, which 'tis now time I ſhould begin to relate, as ſoon as I have hinted to you by the way, that, for varieties ſake, I made a tryal with Copper calcin'd *per ſe*, that I might not be accuſed of having omitted to employ

employ a Metal whoſe Body Chymiſts ſuppoſe to be much opened by Calcination. And though the event were notable even in Compariſon of that of the experiment made with *Cocheneel*, yet my conjectures inclin'd me much to preferr the way deſcrib'd in the following Account.

We carefully weigh'd out in a pair of tender Scales one grain of Copper not-calcin'd, but barely fil'd; and becauſe, as we made choice of this Metal for its yielding in moſt *Menſtruums* a Blew, which is a deep and conſpicuous colour; we alſo choſe to make a ſolution, not in *Aqua fortis* or *Aqua regis*, but the Spirit of *Sal Armoniack* (as that is an urinous Spirit,) having found by former tryals, that this *Menſtruum* would give a far deeper ſolution than either of the others. This lovely Liquor, of which we us'd a good proportion, that all the Copper might be throughly diſſolved, we put into a tall cylindrical Glaſs of about four inches in Diameter, and by degrees pour'd to it of diſtill'd Water,

Water, which is more proper in this caſe than common Water, which has oftentimes an inconvenient Saltiſhneſs, 'till we had almoſt fill'd the Glaſs, and ſaw the colour grow ſomewhat pale, without being too dilute to be manifeſt; and then we warily pour'd this liquor into a conical Glaſs, that it might be the more eaſie to fill the veſſel ſeveral times to the ſame height. This conical Glaſs we filled to a certain mark four times conſecutively, weighing it, and the liquor too, as often in a pair of excellent Scales purpoſely made for Statical experiments, and which, though ſtrong enough to weigh ſome pounds in each Scale, would, when not too much loaden, turn with about one grain. Theſe ſeveral weights of the Glaſs, together with the contained liquor, we added together, and then carefully weighing the empty Glaſs again, we deducted four times its weight from the above-mentioned ſumm, and thereby found the weight of the liquor alone, to be that, which

reduc'd

reduc'd to grains amounted to 28534; so that a grain of Copper, which is not full half so heavy *in specie* as fine Gold, communicated a Tincture to 28534 times its weight.

But now if you please to take notice, that the scope of my Experiment was to shew, into what a number of parts one grain of Copper might be divided, you will allow me to consider, as I did, that this multitude of parts must be estimated by the Proportion, not so much in weight as in bulk, of the tinging Metal to the tinged Liquor, and consequently, since that divers Hydrostatical tryals have inform'd me, that the weight of Copper to the weight of Water of the same bulk is *proximè* as 9 to 1, a grain-weight of Copper is in bigness but the ninth part of as much Water as weighs a grain; and so the formerly mention'd number of the grains of Water must be multiplied by 9, to give us the Proportion between the tinging and tinged Bodies, that is, that a single grain of Copper

Copper gave a blewneſs to above 256806 parts of limpid Water, each of them as big as it. Which, though it may ſeem ſtupendious, and ſcarce credible; yet I thought fit to proſecute the Experiment ſomewhat farther, by pouring all the liquor out of the tall cylindrical Glaſs into another clean veſſel, whence filling the conical Glaſs twice, and emptying it as often into the ſame cylindrical Glaſs, the third time I fill'd the conical Glaſs with colourleſs diſtill'd Water, and pouring that alſo into the cylindrical Glaſs, we found the mixt liquor to have yet a manifeſt, though but a pale, blewneſs. And, laſtly, throwing away what was in the cylindrical Glaſs, we poured into it, out of the ſame conical Glaſs, equal parts of diſtill'd colourleſs Water, and of the tincted Liquor we had formerly ſet apart in the clean Veſſel, and found, that, though the colour were very faint and dilute, yet an attentive Eye could eaſily diſcern it to be blewiſh; and ſo it was judg'd

by an intelligent Stranger that was brought in to look upon it, and was desir'd to discover of what colour he thought it to be. Whereby it appears, that one grain of Copper was able to impart a colour to above double the quantity of Water above mentioned.

This Experiment I have allow'd my self to be the longer and more particular in relating, both because I know not, that any such has been hitherto either made or attempted, and because it will probably gratifie your Chymists, that love to have the Tinctures of Metals believ'd very diffusive; and because, if Circumstances were not added, it would seem to you as well incredible, as perhaps it does seem stupendious, that a portion of matter should be able to impart a *conspicuous* colour to above 256806 times its bulk of Water, and a manifest tincture to above 385200, (for so it did, when the proportion of the ting'd part to the whole mixture, made of it and the ting'd

part,

part, was as 2 to 31,) and a faint, but yet *discernible* and distinguishable colour to above five hundred and thirteen thousand six hundred and twenty times its bulk of Water.

CHAP. IV.

IT were easie for me (*Pyroph.*) to give you several Instances, to shew, that the *Effluvia* of *Liquors* may get in at the Pores of Bodies that are reputed of a close Texture, but I shall at present forbear to mention such Examples, not only because they belong to another place*, where I take notice of them, but because many such would not seem so remarkable, nor be so considerable to our present purpose, as a few taken from Bodies that are *not Fluid*.

* *A Discourse of* Pores *of Bodies, and* Figures *of Corpuscles.*

And first, it is deliver'd by Writers

of good credit, that ſeveral Perſons, (for the Experiment does not hold in all) by barely holding for ſome time dryed *Cantharides* in their hands, have been put to much pain at the neck of the Bladder, and have had ſome other parts miniſtring to the ſecretion of Urine ſenſibly injured. That this is true, I am induced to believe, by what I have elſewhere related to you of the unwelcome experiment I had of the effect of *Cantharides* applied but outwardly to my neck, and that unknown to me, upon the Urinary Paſſages; and that theſe Operations are due to material Effluxes, which, to get into the Maſs of Blood, muſt paſs through the pores of the skin, you will not, I preſume, put me to prove.

Scaliger Exercit. 186. relates, that in *Gaſcony*, his Countrey, there are Spiders of that virulency, that, if a man treads upon them to cruſh them, their poyſon will paſs through the very ſoles of his Shooes. Which ſtory, notwithſtanding the Reputation of

of the Author, I ſhould perhaps have left unmention'd, becauſe of a much ſtranger about Spiders, which he relates in the ſame Section, but that I met with one that is analogous in the diligent *Piſo*'s late Hiſtory of *Braſile*; where, having ſpoken of another venemous Fiſh of that Country, and the Antidotes he had ſucceſsfully uſed to cure the hurts it inflicts, he proceeds to that Fiſh the Natives call *Amoreatim*, of one kind whereof, call'd by the *Portugals Peize Sola*, his words are theſe; *Quæ mira-ſanè efficacia non ſolum manum vel leviſſimo attactu, ſed & pedem, licet optimè calceatum, Piſcatoris incautè piſciculum conterentis, Paralyſi & Stupore afficit, inſtar Torpedinis Europæ, ſed minus durabili.* Lib. 5. cap. 14.

What I ſhall ere long have occaſion to tell you of the power of the *Torpedo*, and ſome other Animals, to affect the Hand and Arm of him that ſtrikes them, ſeems applicable to the matter under conſideration: For, though their affecting the ſtriker at

a diſtance, may very well be aſcrib'd to the ſtupefactive or other venemous Exhalations that expire (and perhaps are as it were darted) from the Animal irritated by the ſtroke, and are breath'd in together with the air they infect; yet their benumming, or otherwiſe affecting the Arm that ſtruck them, rather than any other part, ſeems to argue, that the poyſonous ſteams get in at the pores of the skin of the Limb, and ſo ſtupifie, or otherwiſe injure, the nervous and muſculous parts of it.

Other Examples belonging to this Section may be referr'd hither from divers other places in theſe Papers about Occult Qualities, and therefore I ſhall only add here that moſt remarkable Proof, *That ſome Emanations, even of ſolid Bodies, may be ſubtil enough to get through the pores, even of the cloſeſt Bodies*; which is afforded us by the *Effluvia* of the Loadſtone, which are by Magnetical Writers ſaid to penetrate without reſiſtance all kind of Bodies. And though

though I have not tryed this in all ſorts, yet having tryed it in Metals themſelves, I am apt to think, the general Rule admits of very few Exceptions, eſpecially, if that can be fully made out, which is affirm'd about the perviouſneſs of Glaſs to the Effluxions of the Loadſtone. For, not only Glaſs is generally reputed to be as cloſe a Body as any is, but (which weighs more with me) I have by Tryals purpoſely made, had occaſion to admire the cloſeneſs of very thin pieces of Glaſs. But the reaſon why I juſt now expreſs'd my ſelf with an *If*, was, becauſe I was not entirely ſatisfied with the Proof wont to be acquieſc'd in, of the perviouſneſs of Glaſs, namely, that in Dials and Sea-Compaſſes that are cover'd with plates of Glaſs, the Needle may be readily moved to and fro by a Loadſtone held over it. For theſe Plates being commonly but faſten'd on with Wax, or at beſt with Cement, a Sceptick may pretend, that the magnetical *Effluvia*

pass not through the Glass; but through that much more pervious matter, that is imployed to secure the Commissures, only from the access of the Air. To put then the matter past doubt, I caused some Needles to be Hermetically seal'd up in Glass-pipes; which being laid upon the surface of water (whereon by reason of the bigness of the Cavities they would lightly float,) the included Needles did not only readily feel the virtue of an externally applied Loadstone, (though but a weak one) but complied with it so well, that I could easily, by the help of the Needle, lead, without touching it, the whole Pipe, this was shut up in, to what part of the surface of the water I pleased. And I also found, that by applying a better Loadstone to the upper part of a sealed Pipe, and a Needle in it, I could make the Needle leap up from the lower part as near to the Loadstone as the interposed Glass would give it leave.

But I thought it would be more considerable, to manifest that the

Magne-

Magnetical *Effluvia*, even of ſuch a dull Body, as the Globe of the Earth, would alſo penetrate Glaſs. And though this ſeem difficult to be tryed, becauſe no ordinary Loadſtone, nor any Iron touch'd by it, was to be imployed to work on the included Iron; yet I thought fit to attempt it after this manner; I took a cylindrical piece of Iron of about the bigneſs of ones little finger, and between half a foot and a foot long, (for I had formerly obſerved, that the quantity of unexcited Iron furthers its Operation upon excited Needles,) and having Hermetically ſeal'd it up in a Glaſs-pipe but very little longer than it; I ſuppoſed, that if I held it in a perpendicular poſture, the Magnetical *Effluvia* of the Earth, penetrating the Glaſs, would make the lower extreme of the Iron anſwerable to the North Pole; and therefore having applied this to the point of the Needle in a Dial, or Sea-Compaſs, that look'd toward the North, (for Authors mean not all the ſame thing by the

the Northern Pole of a Needle or Loadſtone,) I preſum'd it would, according to the Laws Magnetical (elſewhere mention'd) drive it away, which accordingly it did. And having for farther tryal inverted the included Iron, (ſo that the end which was formerly the lowermoſt, was now the uppermoſt) and held it in a perpendicular poſture juſt under the ſame point of the Needle, that extreme of the Iron-rod, which before had driven away this point, being by this inverſion become (in a manner) a South-Pole, did (according to the ſame Laws) attract it: By which ſudden change of Poles, meerly upon the change of ſituation, it alſo appear'd, that the Iron ow'd its Virtue only to the Magnetiſm of the Earth, not that of another Loadſtone, which would not have been thus eaſily alterable. And this Experiment I the more particularly relate, becauſe this is not the only place, where I have occaſion to make uſe of it.

CHAP.

CHAP. V.

ANother proof of the great Subtilty of *Effluviums*, may be taken from the ſmall Decrement of weight or bulk that a Body may ſuffer by parting with great ſtore of ſuch Emanations.

That Bodies, which infus'd in Liquors impregnate them with new Qualities ſuitable to thoſe of the immers'd Bodies, do ſo by imparting to them ſomewhat of their own Subſtance, will, I preſume, be readily granted by thoſe that conceive not, how one Body ſhould communicate to another a ſolitary and naked Quality, unaccompanied by any thing Corporeal to ſupport and convey it. But I would not have you think, *Pyrophilus*, that the only matter of fact I have to countenance this notion, is that Experiment, which has convinc'd divers Chymiſts and Phyſicians, otherwiſe not

not friends to the Corpuscular Philosophy, that Medicines may operate without any consumption of themselves. For, *though* divers of these, some of them Learned men, have confidently written, that *Glass of Antimony* and *Crocus Metallorum*, being either of them infus'd in a great proportion of Wine, will make it vomitive; and if that liquor be poured off, and new be poured on, every new portion of such liquor will be impregnated with the same virtue, and this though the liquor be chang'd a thousand times, and yet the *Antimonial Glass* or *Crocus* will continue the same as well in weight as virtue; and *though* thence some of them, especially Chymists, argue, that some Metals without imparting any thing substantial, but only, as *Helmont* speaks of some of his *Arcana*, by irradiation: *Yet*, I confess, I have some doubts, whether the Experiment have been competently tryed, and shall not fully acquiesce in what has been said, till some skilful Experimenter deliver it upon his own

own Tryal, and acquaint us too, with what Inſtruments and what Circumſpection he made it. For, beſides that the Ingeniouſeſt Phyſicians I have queſtion'd about it, acknowledg'd the Taſt, and ſometimes the Colour of the Wine to be alter'd by the infus'd Mineral, I could not acquieſce in the affirmation of an ordinary Chymiſt or Apothecary, or even Phyſician, if he ſhould barely averr, that he had weigh'd an Antimonial Medicine before 'twas put to infuſe, and after the infuſion ended, and obſerv'd no decrement of weight. For I have had too much experience (as I elſewhere mention) of the difficulty of making exact Statical tryals, not to know, that ſuch Scales, as are wont to be imployed by Chymiſts and Apothecaries in weighing Drugs, are by no means fit to make tryals with the nicety which that I am ſpeaking of requires. It being eaſie, even with the better ſort of ſuch unaccurate Scales, eſpecially if they be not ſuſpended from ſome fixt thing,

but

but held with the hand, to mistake half a grain or a grain, and perhaps a greater quantity, and at least more than by divers of the Experiments of this Essay appears necessary to be spent upon the impreghating of a considerable proportion of Liquor with Corporeal Effluxions. Besides, that if, when the beaten *Crocus* or *Glass* be taken out of the Wine to be weigh'd again, the Experimenter be not cautious enough to make allowance for the Liquor that will adhere to the Medicament, 'tis plain that he may take notice of no decrement of weight, though there may be really *Effluviums* of the Mineral amounting to several grains, imbib'd by the Liquor. And though he be aware of this, and dry the powder, yet 'tis not so easie, even for a skilful man, to be sure that none of the more viscous particles of the Liquor stick to the Mineral, and being sensible upon the Ballance, though not to the Eye or Hand, repair the recess of those emetick Corpuscles that diffus'd them-

themſelves into the *Menſtruum*. And the ſenſe of theſe difficulties put me upon the attempting to make ſo noble an Experiment with excellent Scales, and the care that it deſerves: But after a long tryal, an unlucky accident fruſtrated at laſt my endeavours. But though, till competent Relators give us an account of this matter upon their own tryal, and repeat the Infuſion very much oftener, than, for ought I find, any man has yet done, I muſt not acquieſce in all that is ſaid of the Impregnation of Wine or other Liquors by *Antimonial Glaſs* and *Crocus Metallorum*; yet that after divers repeated Infuſions the Mineral ſubſtance ſhould not be ſenſibly diminiſh'd in bulk or virtue, may well ſuffice to make this Inſtance, though not the only or chief that may be brought for our purpoſe, yet a pertinent one to it. For that there is a powerful Emetick Quality imparted to the Liquor, is manifeſt by experience; and that the Mineral does not impart this virtue

as

as 'twere by irradiation, but by substantial effluxion, seems to me very probable; not only because I conceive not, how this can be done otherwise, but because, as 'tis noted above, the Wine does oftentimes change colour by being kept a competent time upon the Mineral, as if it drew thence a Tincture; and even when it is not discolour'd, I think it unsafe to conclude, that the *Menstruum* has not wrought upon it. For I have kept good Spirit of Vinegar for a considerable time upon finely powder'd Glass of Antimony made *per se*, without finding the Spirit to be at all ting'd, though 'tis known, that Antimonial Glass is soluble in Spirit of Vinegar, as mine afterwards appear'd to be, by a longer digestion in the same Liquor. But there may be a great number of minute particles dissolved in the *Menstruum* before they be numerous enough to change the Colour of it. And with this agrees very well what is observ'd, That though too great a quantity of the pre-

prepar'd Antimony be put into the liquor, yet it will not be thereby made too ſtrongly Emetick. For the Wine, being a *Menſtruum*, will, like other *Menſtruums*, be impregnated but to a certain meaſure, without diſſolving the overplus of the matter that is put into it. And *Mars*, which is a harder and heavier body than Glaſs of Antimony, is it ſelf in part ſoluble in good *Rheniſh* or other white Wine, (and that in no long time,) and ſometimes even in Water.

I do not therefore reject the Emetick Infuſion, as unfit to have a place in this Chapter, but till the experiment have been a little more accurately made, I think it inferiour, as to our purpoſe, to ſome of the Inſtances to be met with in the next Chapter, and perhaps alſo to that mention'd by *Helmont*, and tryed by more than one of my Acquaintance, concerning the Virtue of killing Worms, that Mercury imparts to the water or wine wherein it has been long enough infus'd, or elſe for

a while decocted. Though Quick-ſilver given in ſubſtance is commended as an effectual Medicine againſt Worms, not only by many profeſt * Spagyriſts, but by divers ** Methodiſts of good Note. And though, ſome other things, Chymical and Philoſophical, keep me from being of their opinion, who think that in this caſe the Mercury impregnates the liquor as it were by Irradiation, rather than in a Corporeal manner, yet the Eye does not perceive, that even limpid water takes any thing from clean and well purg'd Mercury, which we know that divers corroſive liquors themſelves will not work upon.

* As *Quercetanus, Libavius, Zabata, Burggravius.*

** As *Vidius, Paræus, Caſalpinius*, &c.

To this Inſtance I muſt add one that is yet freer from exceptions, which is, that having for Curioſity ſake ſuſpended in a pair of exact Scales, that would turn with a very ſmall part of a grain, a piece of *Amber-greece* bigger than a Walnut, and

and weighing betwixt an hundred and ſix-ſcore grains, I could not in three days and a half that I had opportunity to make the tryal, diſcover, even upon that Ballance, any decrement of weight in the *Amber-greece*; though ſo rich a perfume, lying in the open Air, was like in that time to have parted with good ſtore of odoriferous Steams. And a while after ſuſpending a Lump of *Aſſa fœtida* five days and a half, I found it not to have ſuſtain'd any diſcernible loſs of weight, though, in ſpite of the unfavourable cold weather, it had about it a neighbouring Atmoſphere repleniſh'd with fœtid exhalations. And when twelve or fourteen hours after, perhaps upon ſome change of weather, I came to look upon it, though I found that in that time the *Æquilibrium* was ſomewhat alter'd, yet the whole Lump had not loſt half a quarter of a grain; which induc'd me to think, that there may perhaps be Steams diſcernible even by our Noſtrils, that are far more ſubtil than the odorous

exhalations of Spices themſelves. For, having in very good Scales ſuſpended in the Month of *March* an ounce of Nutmegs, it loſt in about ſix days five grains and a half. And an ounce of Cloves in the ſame time loſt ſeven grains and five eigths.

You will perhaps wonder, why I do not preferr to the Inſtances I make mention of in this Chapter, that which may be afforded by the Loadſtone, that is acknowledg'd continually to emit multitudes of Magnetical Steams without decrement of weight. But though I have not thought fit to paſs this wholly under ſilence; yet I forbear to lay ſo much ſtreſs on it, not only becauſe my Ballances have not yet ſatisfied me about the *Effluvia* of Loadſtones, (for I take them not all to be equally diffuſive of their Particles;) but becauſe I foreſee it may be doubted, *whether* Loadſtones, like odorous Bodies, do furniſh afreſh of their own, all the Corpuſcles that from time to time iſſue from them? *Or*, whether they

they be not continually repaired, *partly* by the return of the Magnetical Particles to one Pole that ſallied out of the other; and *partly* by the continued paſſage of Magnetical matter (ſupplied by the Earth or other Mundane Bodies) it make the Pores or Channels of the Loadſtone their conſtant Thorow-fares.

I doubt not but it will make it more probable, that a ſmall Quantity of matter being ſcatter'd into inviſible *Effluvia* may be exceedingly rarified and expanded, if it can be made appear, that this little portion of matter ſhall, for a conſiderable time, emit multitudes of viſible parts, and that in ſo cloſe an order among themſelves, as to ſeem in their Aggregate but one intire liquor, endow'd with a ſtream-like motion, and a diſtinct *ſuperficies*, wherein no interruption is to be ſeen, even by an Eye plac'd near it. To deviſe this Experiment, I was induc'd, by conſidering, that hitherto all the (total) diſſolutions that have been made of

Pigments, have been in liquors naturally cold, and conſiſting probably of much leſs ſubtile, and certainly of much leſs agitated parts, than that fluid aggregate of ſhining matter that we call *Flame*; whereas I argued, that if one could totally diſſolve a Body compos'd of parts ſo minute as thoſe of a Metal into actual Flame, and husband its Flame ſo, as that it ſhould not immoderatly waſte, I ſhould thereby diſſolve the Metal in a far more ſubtil *Menſtruum* than our common water, or *Aqua fortis*, or *Aqua Regis*, or any other known *Menſtruum* I have yet imployed. And conſequently the attenuation and expanſion of the Metal in this truly Igneous *Menſtruum* would much ſurpaſs not only what happens in ordinary Metalline ſolutions, but poſſibly alſo what I have noted in the third Chapter of this *Eſſay*, about the ſtrange diffuſion of Copper diſſolv'd in Spirit of Urine and Water. In proſecution of this deſign, I ſo prepar'd one ſingle grain of that Metal,

Metal, by a way that I elſewhere teach, that it was diſſolv'd in about a ſpoonful of an appropriated *Menſtruum*. And then having caus'd a ſmall Glaſs-lamp to be purpoſely blown to contain this liquor, and fitted it with a ſocket and wieck, we lighted the Lamp, which, without conſuming the wieck, burnt with a flame large enough and very hot, and ſeem'd to be all the while of a greeniſh blew, as if it were a but finer and ſhining ſolution of Copper. And yet this one grain of prepar'd Metal ting'd the flame that was from moment to moment produc'd, during no leſs than half an hour and ſix minutes. And now if we conſider, that in this flame there was an uninterrupted Succeſſion of multitudes of colour'd Particles newly extricated, and flying off in every of thoſe many parts wherein a minute of time may either actually or mentally be divided; *and*, if we conſider Flame as a light and very agitated body, paſſing with a ſtream upwards through the Air,

and if we alſo conſider the quantity of liquor that would (as I ſhall by and by tell you) run through a Pipe of a much leſſer diameter than that Flame, within the compaſs of the forementioned time: What a quantity of the ſtreaming fluid we call Flame, if it could have been preſerv'd and collected into one Body, may we ſuppoſe would appear to have iſſued out of one grain of Copper in the ſpace of thirty-ſix minutes; and what a multitude of metalline Corpuſcles may we ſuppoſe to have been ſupplied for the tinging of that Flame during ſo long a time? ſince a Cylindrical ſtream of water falling but through a very ſhort Pipe of glaſs, conſtantly ſupplied with liquors, did paſs at ſuch a rate, that, though the aqueous Cylinder ſeem'd more ſlender by half, (or perhaps by two thirds or better) than the Flame, yet we eſtimated, by the help of a Minute-watch and a good pair of Scales, that, if I had had conveniencies to let it run long enough, the water efflux'd in thirty-

ſix minutes (the time of the Flames duration) would have amounted to above nine gallons, or, (reckoning a pint of water to contain a pound of ſixteen ounces) ſeventy-two pounds.

CHAP. VI.

THE laſt ſort of Inſtances I ſhall propoſe to ſhew the ſtrange Subtilty of *Effluvia*, is of ſuch, as diſcover the great quantity of ſpace that may by a ſmall quantity of matter, when rarified or diſpers'd, be either fill'd as to ſenſe, or, at leaſt, made (as they ſpeak) the ſphear of its activity.

To manifeſt this Truth, and thereby as well confirm the foregoing Chapter, as make out what is deſign'd in this, I ſhall endeavour to ſhew, and help your imagination to conceive, how great a ſpace may be impregnated with the Effluxions of a Body, oftentimes without any ſenſible, and oftener without any conſiderable decrement

crement in bulk or weight of the Body that affords them. And in order to this, though I ſhall not pretend to determine preciſely how little the ſubſtances, I am to inſtance in, would waſte upon the Ballance, becauſe you will very eaſily ſee they are not that way to be examin'd; yet I preſume, you will as eaſily grant, that the decrement of weight would be but inconſiderable, ſince of ſuch light ſubſtances the loſs even of bulk is ſo; which laſt clauſe I ſhall now attempt to make good, by ſetting down ſome Obſervations, partly borrow'd from the writings of approv'd Phyſicians, and partly that my friends and I have made about the durable Evaporation of ſuch ſmall particles of the Effluxions of Animals, as are actually not to be diſcern'd by the Eye to have any of thoſe things ſticking to them, which are ſo very long in flying ſucceſſively away.

'Tis wont to be ſomewhat ſurprizing to men of Letters, when they firſt go a hawking with good Spaniels,

niels, to obſerve, with how great ſagacity thoſe dogs will take notice of, and diſtinguiſh by the ſcent, the places where Partridges, Quails, &c. have lately been. But I have much more wonder'd at the quick ſcent of an excellent Setting-dog, who by his way of ranging the fields, and his other motions, eſpecially of his Head, would not only intimate to us the kinds of game, whoſe ſcent he chanc'd to light on, but would diſcover to us where Partridges had been (though perhaps without ſtaying in that place) ſeveral hours before, and aſſiſt us to gueſs how long they had been gone before we came.

I have had ſtrange anſwers given me in *Ireland*, by thoſe who make a gain if not an intire livelihood by killing of Wolves in that Countrey, (where they are paid ſo much for every head they bring in) about the ſagacity of that peculiar race of dogs they imploy in hunting them; but not truſting much to thoſe Relators, I ſhall add, that a very ſober and diſcreet

diſcreet Gentleman of my acquaintance, who has often occaſion to imploy Blood-hounds, aſſures me, that if a man have but paſs'd over a field, the ſcent will lye (as they ſpeak) ſo as to be perceptible enough to a good dog of that ſort for ſeveral hours after. And an ingenious Hunter aſſures me, that he has obſerv'd, that the ſcent of a flying and heated Deer will ſometimes continue upon the ground from one day to the next following.

And now we may conſider theſe three things; *Firſt*, That the ſubſtance left upon the graſs or ground by the tranſient tread of a Partridge, Hare, or other *animal*, that does but paſs along his way, does probably communicate to the graſs or ground but ſome of thoſe Effluxions, that tranſpire out of his feet, which being ſmall enough to eſcape the diſcernment of the Eye, may probably not amount to one grain in weight, or perhaps not to the tenth part of it. *Next*, That the parts of fluid Bodies,

as

as ſuch, are perpetually in motion, and ſo are the inviſible particles that ſwim in them, as may appear by the diſſolution of Salt or Sugar in water, and the wandering of aqueous Vapours through the Air, even when the Eye perceives them not. And *thirdly*, That though the Atmoſphere of one of theſe ſmall parcels of the exhaling matter we are ſpeaking of, may oftentimes be exceeding vaſt in compariſon of the emittent Body, as may be gueſs'd by the diſtance, at which ſome Setters, or Blood-hounds, will find the ſcent of a Partridge, or Deer; yet in places expos'd to the free air or wind, 'tis very likely that theſe ſteams are aſſiduouſly carried away from their Fountain, to maintain the fore-mention'd Atmoſphere for ſix, eight, or more hours, that is, as long as the ſcent has been obſerv'd to lye, there will be requiſite a continual recruit of ſteams ſucceeding one another: And that ſo very ſmall a portion of matter as that which we were ſay-

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ing the *fomes* of theſe ſteams may be judg'd to be, being ſenſibly to impregnate an Atmoſphere incomparably greater than it ſelf, and ſupply it with almoſt continual recruits, we cannot but think, that the ſteams it parts with, muſt be of an extreme and ſcarce conceivable minuteneſs.

And we may further conſider, that the ſubſtances, which emit theſe ſteams, being ſuch as newly belong'd to Animals, and were, for the moſt part, tranſpir'd through the pores of their feet, muſt be in likelihood a far more evaporable and diſſipable kind of Bodies than Minerals or aduſt Vegetables, ſuch as Gunpowder is made of; ſo that if the grains of Gunpowder emit Effluviums capable of being by ſome Animals perceiv'd at a diſtance by their ſmell, one may probably ſuppoſe, that the ſmall grains of this powder may hold out very many times longer to ſupply an Atmoſphere with odorable ſteams, than the Corpuſcles left on

the

the ground by tranſient Animals.

Now though it be generally agree'd on, that very few Birds have any thing near ſo quick a ſenſe of ſmelling as Setting-dogs or Blood-hounds, yet that the odour of Gun-powder, eſpecially when aſſiſted by the ſteams of the *Caput mortuum* of Powder formerly fir'd in the ſame Gun, may by Fowls be ſmelt at a notable diſtance, particularly when the wind blew from me towards them, I often perſwaded my ſelf I obſerv'd, eſpecially as to Crows, when I went a ſhooting; and was confirm'd in that opinion, both by the common Tradition, and by ſober and ingenious perſons much exercis'd in the killing of Wild-fowl, and of ſome fourfooted Beaſts.

I had forgotten to take notice of one Obſervation of the experienc'd *Julius Palmarius*: Whence we may learn, that Beaſts may leave upon the Vegetables, that have touch'd their bodies for any time, ſuch Corpuſcles, as, though unheeded by other

other Animals, may, when eaten by them, produce in them ſuch diſeaſes as the infected Animals had. For this Author writes in his uſeful Tract *de morbis Contagioſis*, that he obſerv'd Horſes, Beeves, Sheep and other Animals, to run mad upon the eating of ſome of the ſtraw on which ſome mad Swine had layn.

And now to reſume and proſecute our former diſcourſe, you may take notice, that the *Effluvia*, mention'd to have been ſmelt by Animals, are, though inviſible, yet big enough to be the objects of ſenſe; ſo that 'tis not improbable, that, among the ſteams that no ſenſe can immediately perceive, there ſhould be ſome far more ſubtil than theſe, and conſequently capable of furniſhing an Atmoſphere much longer, without quite exhauſting the effluviating matter that afforded them.

* *Foreſtus*, an uſeful Author, recites an Example of Peſtilential contagion long preſerv'd in a Cobweb.

* *Lib. 6. Obſerv.* 22.

Alexan-

Alexander Benedictus writes also, that at *Venice* a Flock-bed did for many years harbour a pestiferous malignity to that degree, that when afterwards it came to be beaten, it presently infected the by-standers with the Plague.

And the Learned * *Sennertus* himself relates, that in the year 1542. there did in the City of *Uratislavia* (vulgarly *Breslaw*,) where he afterwards practised Physick, dye of the Plague, in less than six Months, little less than six thousand men, and that from that time the Pestilential Contagion was kept folded up in a linnen cloth about fourteen years, and at the end of that time being display'd in another City, it began a Plague there, which infected also the neighbouring Towns and other places.

* *Lib.* 4. *de Feb. cap.* 3.

* *Trincavella* makes mention of a yet lastinger Contagion, (which occasion'd the death of ten thousand

* *Libr.* 3. *Con.* 17.

 persons)

perſons) that lay lurking in certain Ropes, with which at *Juſtinopolis* thoſe that dy'd of the Plague had been let down into their Graves.

But, though none of theſe Relations ſhould to ſome Criticks appear ſcarce credible, it may be objected, that all theſe things, wherein this Contagion reſided, were kept cloſe ſhut up, or at leaſt were not expos'd to the Air. Wherefore having only intimated, that the exception, which I think is not irrational, would, though never ſo true, but *leſſen* the wonder of theſe ſtrange Relations, without rendering them *unfit* for our preſent purpoſe, I ſhall add, that though 'tis the opinion of divers Learned Phyſicians, that the matter harboring Contagion cannot laſt above Twenty or a few more days, if the Body it adheres to be expos'd to the free air and the wind, and though I am not forward to deny, that their judgement may hold in ordinary caſes; yet I muſt not deny neither, that a Contagion may ſometimes

times happen to be much more tenacious and obſtinate: Of which I ſhall give but that one, almoſt recent inſtance, obſerv'd by the Learned * *Dimmerbrook* in his own Apothecary, who having but remov'd with his foot, from one ſide to the other of a little Arbour (in his Garden) ſome ſtraw, that had layn under the Pallet, on which near eight Months before a Bed had layn, wherein a Servant of the Apothecaries, that recover'd, had been ſick of the Plague; the infectious ſteams preſently invaded the lower part of his leg, and produc'd a pungent pain and bliſter, which turn'd to a peſtilential Carbuncle, that could ſcarce be cur'd in a Fortnight after, though during that time the Patient were neither feaveriſh, nor, as to the reſt of his Body, ill at eaſe. This memorable inſtance, together with ſome others of the like kind, that our Author obſerved in the ſame City (of *Nimmegen*) obtain'd, not to ſay,

* *Lib. 4. de Peſte.*

extorted, even from him, this Confeſſion; which I add, becauſe it contains ſome conſiderable, and not yet mentioned Circumſtances of the recited caſe: *Hoc exemplo Medicorum Doctrina de Contagio in fomite latente ſatis confirmatur. Mirum tamen eſt, hoc Contagium tanto tempore in prædicto ſtramine potuiſſe ſubſiſtere, utpote quod tota hyeme ventis & pluviis*, (he adds in another place) *nivibus & frigori, expoſitum fuiſſet.*

And now I will ſhut up this Chapter with an inſtance, that ſome will think, perhaps, no leſs ſtrange than any of the reſt, which is, that though they that are skilful in the perfuming of Gloves, are wont to imbue them with but an inconſiderable quantity of odoriferous matter, yet I have by me a pair of *Spaniſh* Gloves, which I had by the favour of your fair and virtuous Siſter (*F.*) that were ſo skilfully perfum'd, that partly by her, partly by thoſe, that preſented them her as a Rarity, and partly by me, who have kept them ſeveral

ſeveral Years, they have been kept about eight or nine and twenty years, if not thirty, and they are ſo well ſcented, that they may, for ought I know, continue fragrant divers years longer. Which inſtance, if you pleaſe to reflect upon, and conſider, that ſuch Gloves cannot have been carried from one place to another, or ſo much as uncover'd (as they muſt often have been) in the free Air, without diffuſing from themſelves a fragrant Atmoſphere, we cannot but conclude thoſe odorous Steams to be unimaginably ſubtile, that could for ſo long a time iſſue out in ſuch ſwarms, from a little perfum'd matter lodged in the pores of a Glove, and yet leave it richly ſtock'd with particles of the ſame nature; though, (eſpecially by reaſon of ſome removes, in which I took not the Gloves along with me,) I forgot ever ſince I had them, to keep them ſo much as ſhut up in a Box.

OF

Of the

GREAT EFFICACY OF EFFLUVIUMS:

ET

The Honorable *ROBERT BOYLE.*

OF THE GREAT EFFICACY OF *EFFLUVIUMS.*

CHAP. I.

THey that are wont in the Eſtimates they make of Natural Things, to truſt too much to the negative informations of their Senſes, without ſufficiently conſulting their Reaſon, have commonly but a very little and ſlight opinion of the Power and Efficacy of *Effluviums*; and imagine that ſuch minute Corpuſcles (if they grant that there are ſuch,) as are not, for the moſt part of them, capable to work upon the

tendereſt and quickeſt of Senſes, the Sight, cannot have any conſiderable Operation upon other Bodies. But I take this to be an error, which, *as* it very little becomes Philoſophers, *ſo* it has done no little prejudice to Philoſophy it ſelf, and perhaps to Phyſick too. And therefore though the nature of my deſign at preſent did not *require* it, yet the importance of the ſubject would *invite* me to ſhew, That this is as ill-gounded as prejudicial a Suppoſition.

And indeed if we Conſider the ſubject attentively, we may obſerve, That though it be true, that, *cæteris paribus*, the greatneſs of Bodies doth, in moſt caſes, contribute to that of their Operation upon others, yet Matter or Body being in its own preciſe nature an unactive or moveleſs Subject, one part of the Maſs acts upon another but upon the account of its Local Motion, whoſe Operations are facilitated and otherwiſe diverſified by the Shape, Size, Situation and Texture both of the Agent and of the Patient.

Patient. And therefore if Corpuſcles, though very minute, be numerous enough, and have a competent degree of motion, even theſe ſmall Particles, eſpecially if fitly ſhap'd, when they chance to meet with a Body, which the congruity of its texture diſpoſes to admit them at its Pores, and receive their either friendly or hoſtile impreſſions, may perform ſuch things in the patient, as viſible and much groſſer Bodies, but leſs conveniently ſhap'd and mov'd, would be utterly unable (on the ſame Body) to effect.

And that you may with the leſs difficulty allow me to ſay, that the Effluviums of Bodies, as minute as they are, may perform Conſiderable things, give me leave to obſerve to you, that there are *at leaſt* ſix ways, by which the Effluviums of a Body may notably operate upon another; namely, 1. By the *great number* of emitted Corpuſcles. 2. By their *penetrating* and pervading nature. 3. By their *celerity*, and other Modifications of their Motion. 4. By the *congruity* and *incon-*

gruity of their Bulk and Shape to the Pores of the Bodies they are to act upon. 5. By the *motions* of *one* part *upon another*, that they excite or occasion in the Body they work upon according to its Structure. And 6*ly*, By the Fitness and Power they have to make themselves be *assisted*, in their Working, by the *more Catholick Agents* of the Universe. And though it may perhaps be sufficiently proved, that there are several cases wherein a Body that emits Particles, may act notably upon another Body by this or that single way of those I have been naming; yet usually the great matters are performed by the association of two, three or more of them, concurring to produce the same Effect. Upon which score when I shall in the following Paper referr an Instance or a Phenomenon to any one of the forementioned Heads, I desire to be understood as looking upon that but as the Head, to which it *chiefly* relates, without excluding the rest.

CHAP.

CHAP. II.

TAking thoſe things for granted, that have, I hope, been ſufficiently proved in the former Tract about the ſubtlety of Effluviums, I ſuppoſe it will readily be allowed, That the Emanations of a Body may be extremely minute; whence it may be rightly inferr'd, that a ſmall portion of matter may emit great multitudes of them.

Now that the great number of Agents may in many caſes compenſate their littleneſs, eſpecially where they Act or Reſiſt *per modum unius*, (as they ſpeak,) men would perhaps the more eaſily grant, if they took notice to this purpoſe of ſome familiar Inſtances.

We ſee that not only leſſer Land-floods that overflow the neighbouring Fields, but thoſe terrible Inundations that ſometimes drown whole Countreys, are made by Bodies ſingly ſo ſo ſmall and inconſiderable as Drops

of Rain when they continue to fall in thoſe multitudes we call Showers.

So the aggregates of ſuch minute Bodies as grains of Sand being heaped together in ſufficient Numbers, make Banks wherewith greateſt Ships are ſometimes ſplit, nay and ſerve in moſt places for Bounds to the Sea it ſelf.

And though a ſingle Corn of Gunpowder, or two or three together, are not of Force to do much miſchief, yet two or three Barrels of thoſe Corns taking Fire all together are able to blow up Ships and Houſes, and perform prodigious things.

But inſtead of multiplying ſuch Inſtances, afforded by Bodies of ſmall indeed but yet viſible Bulk, I ſhall (as ſoon as I have intimated, that the above-mentioned drops of Rain themſelves conſiſt of convening Multitudes of Vapors moſt commonly Inviſible in their Aſcent,) endeavour to make out what was propoſed, by two or three Inſtances drawn from the Operations of Inviſible particles.

And firſt, we ſee, that though Aqueous

Aqueous Vapours be look'd upon as the faintest and least active Effluviums that we know of, yet when multitudes of them are in Rainy weather disperſed thorow the Air, and are thereby qualified to work on the Bodies expoſed to it, their Operations are very conſiderable, not only in the diſſolution of Salts, as Sea-Salt, Salt of Tartar, &c. and in the putrefactive changes they produce in many Bodies, but in the intumeſcence they cauſe in Oak and other ſolid Woods, as appears by the difficulty we often find in and before Rainy weather, to ſhut and open Doors, Boxes, and other Wooden pieces of work, that were before fit enough for the Cavities they had been adjuſted to.

I might here urge, that though the ſtrings of Viols and other Muſical Inſtruments are ſometimes ſtrong enough to ſuſtain conſiderable weights, yet if they be left ſcrewed to their full tenſion, (as it frequently happens) they are oftentimes by the ſupervening of moiſt weather made to break, not

without impetuosity and noise. But it may sute better with my present aim, if I mention on this occasion, (what I elsewhere more fully take notice of:) Being desirous to try what a multitude even of Aqueous Steams may do, I caused a Rope that was long, but not thick, and was in part sustained by a Pully, to have a Weight of Lead so fastned to the end of it, as not to touch the ground, and after the Weight had leisure allowed it to stretch the Cord as far as it could, I observed that in the moist weather the wateriſh particles, that did invisibly abound in the Air, did so much work upon and shorten the Rope, as to make it lift up the hanging Weight, which was, if I mis-remember not, about an hundred Pounds.

The invisible Steams, issuing out of the Walls of a newly plaster'd or whited Room, are not sensibly prejudicial to those that do but transiently visit it, or make but a very short stay in it, though there be a Charcoal-fire in the Chimney; but we have many instances

inſtances of perſons, that by lying for a night in ſuch Rooms, have been the next morning or ſooner found dead in their Beds, being ſuffocated by the multitude of the noxious Vapours emitted during all that time.

And here I think it proper to obſerve, That it may much aſſiſt us to take notice of the multitude of *Effluvia*, and make us expect great matters from them, to conſider, that they are not emitted from the Body that affords them all at once, as Hail-ſhot out of a Gun, but iſſue from it as the Vaporous Winds do out of an Æolipil well heated, or Waters out of a Spring-head in continued Streams, wherein freſh parts ſtill ſucceed one another; ſo that though as many Effluxions of a Body as can be ſent out at one time were numerous enough to Act but upon its Superficial parts, yet the Emanation of the next minute may get in a little farther, and each ſmalleſt portion of time ſupplying freſh Recruits, and perhaps urging on the Steams already entred, the Particles may

may at length get into a multitude of the pores of the invaded Body, and penetrate it to the very innermost parts.

Chap. III.

I Come now to shew in the second place, That the subtile and penetrating nature of Effluviums, may in many cases cooperate with their multitude in producing notable effects; and that there are Effluviums of a very piercing nature, though we shall not now enquire upon what account they are so, we may evince by several Examples. For not only the invisible Steams of good *Aqua Fortis* and Spirit of Nitre do usually in a short time, and in the cold, so penetrate the corks wherewith the Glasses that contained them were stop'd, as to reduce them into a yellow pap; but also the emanations of Mercury have been sometimes found in the

the form of coagulated, or even of running Mercury in the heads or very bones of those Gilders, or Venereal Patients, that have too long or too unadvisedly been exposed to the fumes of it, though they never took Quicksilver in its gross substance. Chymists too often find in their Laboratories, that the steams of Sulphur, Antimony, Arsnick, and divers other Minerals, are able to make those stagger, or perhaps strike them down, that without a competent wariness unlute the Vessels wherein they had been distilled or sublimed; of which I have known divers sad Examples. And of the Penetrancy even of animal Steams we may easily be perswaded, if we consider, how soon in many Plagues the contagious, though invisible, Exhalations are able to reach the Heart, or infect other internal parts; though in divers of these cases the Blood helps to convey the infection, yet still the Morbifick particles must get into the body before they can infect the mass of Blood. And in those stupefactions that

are

are cauſed at a diſtance by the *Torpedo*, the parts mainly affected ſeem to be the Nervous ones of the Hand and Arm, which are of the moſt retired and beſt fenced parts of thoſe members. And there is a Spirit of *Sal Armoniack*, that I make to ſmell to, whoſe inviſible Steams, unexcited by heat, are of ſo piercing a nature, that not only they will powerfully affect the Eyes and Noſtrils, and Throats, and ſometimes the Stomachs too (yet without proving Vomitive,) of the Patients they invade, but alſo when a great cold has ſo clog'd the organs of ſmelling, that neither ſweet nor ſtinking odours would at all affect them, theſe piercing Steams have not only in a few minutes both made themſelves a way, and which is more, ſo open'd the paſſages, that ſoon after the Patient has been able to ſmell other things alſo. And by the ſame penetrating Spirit, a perſon of Quality was, ſome time ſince, reſtored to a power of ſmelling, which he had loſt for divers Years, (if he ever had it equally with other men.) I could eaſily

eaſily ſubjoyn Examples of this kind, but they belong to other places. And here I ſhall only add, that the ſteams of Water it ſelf aſſiſted by warmth, are capable of diſſolving the Texture of even hard and ſolid bodies, that are not ſuſpected to be Saline; as appears by the Philoſophical calcination (as Chymiſts call it) wherein ſolid pieces of Harts-horn are brought to be eaſily friable into pouder, by being hung over waters, whil'ſt their ſteams riſe in diſtillation and without the help of Furnaces. The Exhalations, that uſually ſwim every night in the air, and almoſt every night fall to the ground in the form of Dews (which makes them be judged Aqueous,) are in many places of the Torrid Zone of ſo penetrating a nature, that, as Eye-witneſſes have informed me, they would in a very ſhort time make Knives ruſt in their ſheaths, and Swords in their ſcabbards, nay and Watches in their caſes, if they did not conſtantly carry them in their pockets. And I have known even in *England* divers

divers hard bodies, into which the Vapours ſwimming in the air have inſinuated themſelves, ſo far as to make them friable throughout. But of the penetration of Effluviums, I have given, in ſeveral places, ſo many inſtances, that 'tis not neceſſary to add any here. And therefore to ſhew, that, as I intimated at the beginning of this Chapter, the Penetrancy and the multitude of Effluviums may much aſſiſt each other, I ſhall now ſubjoyn, That we muſt not for the moſt part look upon Effluviums as ſwarms of Corpuſcles, that only beat againſt the outſides of the Bodies they invade, but as Corpuſcles, which by reaſon of their great and frequently recruited numbers, and by the Extreme ſmallneſs of their Parts, inſinuate themſelves in multitudes into the minute pores of the bodies they invade, and often penetrate to the innermoſt of them; ſo that, though each ſingle Corpuſcle, and its diſtinct action, be inconſiderable, in reſpect of the multitude of parts that compoſe

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the body to be wrought on; yet a vaſt multitude of theſe little Agents working together upon a correſpondent number of the ſmall parts of the body they pervade, they may well be able to have powerful effects upon the Body, that thoſe parts conſtitute; as, in the caſe mentioned in the former Chapter, the Rope would not probably have been enabled to raiſe ſo great a weight, though a vehement Wind had blown againſt it, to make it loſe its perpendicular ſtraightneſs, but a vaſt multitude of Watery Particles, getting by degrees into the pores of the Rope, might, like an innumerable company of little wedges, ſo widen the pores as to make the thrids or ſplinters of Hemp, the Rope was made up of, ſwell, and that ſo forcibly, that the depending weight could not hinder the ſhortning of the Rope, and therefore muſt of neceſſity be rais'd thereby. And I have more than once known ſolid and even heavy Mineral Bodies, burſt in pieces by the moiſture of the Air, though

we

we kept them within-doors carefully ſhelter'd from the Rain.

Chap. IV.

That the *Celerity* of the motion of very minute Bodies, eſpecially conjoyned to their multitudes, may perform very notable things, may be argued from the wonderful effects of fired Gunpowder, *Aurum fulminans*, of Flames that inviſibly touch the Bodies they work on, and alſo Whirlwinds, and thoſe ſtreams of inviſible Exhalations and other aerial Particles we call Winds. But becauſe inſtances of this ſort ſuit not ſo well with the main ſcope of this Tract, I ſhall not inſiſt on them, but ſubjoyn ſome others, which, though leſs notable in themſelves, will be more congruous to my preſent Deſign. That the Corpuſcles whereof Odours conſiſt, ſwim to and fro in the Air, as in a fluid Vehicle, will by

by moſt, I preſume, be granted, and may be eaſily prov'd. But I have elſewhere ſhewn, That the motion of the Effluviums of ſome ſufficiently odorous Bodies, has too little Celerity to make a ſenſible impreſſion on the organs of ſmelling, unleſs thoſe Steams be aſſiſted to beat more forcibly upon the Noſtrils by the Air, which hurries them along with it, when it enters the Noſtrils in the form of a ſtream, in the act of Inſpiration. And I have by familiar obſervation of Hunters, Fowlers, and partly of my own made manifeſt, that Setting-dogs, Hounds, Crows and ſome other animals, will be much more affected with ſents, or the odorous *Effluvia* of Partridges, Hares, Gunpowder, *&c.* when the Wind blows from the object towards the ſenſory, than when it ſits the contrary way, which way ſoever the Noſtrils of the animal be obverted, ſo the Air be imbued with the odorous Steams: And conſequently the difference ſeems to proceed from this, that when the Noſtrils are obverted

to the Wind, the Current of the Air drives the Steams forcibly upon the Sensory, which otherwise it does not.

That there is a briskness of motion requisite, and more than ordinarily conducive to *Electrical* attractions, may be argued from the necessity that we usually find by rubbing Amber, Jett, and other Electrical bodies, to make them emit those Steams, by which 'tis highly probable their action is performed: And though I have elsewhere shewn, that this precedent rubbing is not alwayes necessary to excite all Electrical bodies; yet in those that I made to attract without it, it would operate much more vigorously after attrition; which I conceive makes a reciprocal motion amongst the more stable parts, and does thereby as 'twere discharge and shoot out the attracting Corpuscles; whose real emission, though it may be probably argued from what has been already said, seems more strongly proveable by an Observation that

I made

I made many years ago, and which I have been lately inform'd to have been long ſince made by the very Learned *Fabri*. The Obſervation was this; That if, when we took a vigorouſly excited Electrick, we did at a certain nick of time (which circumſtances may much vary, but was uſually almoſt as ſoon as the body was well rubbed) place it at a juſt diſtance from a ſuſpended Hair or other light body, or perhaps from ſome light powder; the Hair, *&c.* would not be attracted to the Electrick, but driven away from it, as it ſeem'd, by the briskly moving ſteams that iſſue out of the Amber or other light body.

This Argument I could confirm by another Phænomenon or two of affinity with this, if I ſhould not borrow too much of what I have elſewhere noted about the Hiſtory of *Electricity*.

I know a certain ſubſtance, which though made by diſtillation, does in the cold emit but a very mild and inoffenſive ſmell, but when the veſſel

that holds it is heated, though no ſeparation of conſtituent Principles appear to be thereby made, (the Body being in all uſual tryals homogeneous,) the Effluviums will be ſo altered, that I remember a Virtuoſo, that, to ſatisfie his curioſity, would needs be ſmelling to it, when 'twas heated, complain'd to me, that he thought the Steams would have killed him, and that the Effluviums of Spirit of *Sal Armoniack* it ſelf were nothing near ſo ſtrong and piercing as thoſe.

And even among ſolid Bodies, I know ſome, which, though abounding much in a ſubſtance wherein ſome rank ſmells principally reſide, yet (if they were not chafed) were ſcarce at all ſenſibly odorous; but upon the rubbing of them a little one againſt the other, the attrition making them, as it were, dart out their Emiſſions, would in a minute or two make them ſtink egregiouſly.

And as the Celerity of motion may thus give a vigor to the Emanations of Bodies, ſo there may be other

other modifications of motion, that may contribute to the ſame thing, and are not to be wholly neglected in this place. For as we ſee, that greater Bodies do operate differingly according to ſuch and ſuch modifications; as there is a great difference between the effects of a Dart or Javelin, ſo thrown as that its point be alwayes forwards, and the ſame weapon if it be ſo thrown, that during its progreſſive motion the extremes turn about the Center of gravity or ſome inward parts, as it happens when Boyes throw ſticks to beat down fruit from the tops of trees; ſo there is little doubt to be made, but that in Corpuſcles themſelves 'tis not all one, as to their effects, whether they move with or without rotation, and whether in ſuch or ſuch a line, and whether with or without undulation, trembling or ſuch a kind of conſecution; and in ſhort, whether the motion have or have not this or that particular modification; which how much it may diverſifie the Effects

of the Bodies moved, may appear by the Motion, that the Aerial particles are put into by Musical Instruments. For, though the effects of harmony, discord and peculiar sounds be sometimes very great, not only in Human bodies, but, as we shall shew in the following Tract, in Organical ones too; the whole efficacy of Musick and of Sounds that are not extraordinarily loud and different, seems, as far as 'tis ascribable to Sonorous bodies, to depend upon the different manners of motion whereinto that Air is put, that makes the immediate impression on our organs of hearing.

Chap. V.

I Should now proceed to shew, how the *Celerity* and other modes, that diversifie the motion of Effluviums, may be assisted to make them operative by their determinate sizes and figures, and

and the congruity or incongruity which they may have upon that score with the Pores of the groſſer Bodies they are to work on: But I think it not fit to entrench upon the ſubject of another * Tract, where the relation between the figures of Corpuſcles and the Pores of groſſer bodies is amply enough treated of. And therefore I ſhall only in this place take notice of thoſe effects of Lightning, which ſeem referable, partly to the Celerity and manner of Appulſe, and partly to the diſtinct ſizes and ſhapes of the Corpuſcles that compoſe the deſtructive matter, and to the peculiar relation between the particles of that matter and the ſtructure of the bodies they invade. I know that many ſtrange things that are delivered about the Effects of what the Latins call *Fulmen* (which our Engliſh word *Lightning* does not adæquately render) are but fabulous; but there are but too many that are not ſo; ſome of which I have been

* *Of the* Pores *of Bodies, and* Figures *of Corpuſcles.*

an Eye-witneſs of, within leſs than a quarter of an hour after that the things happened. And though it be very difficult to explicate particularly many of theſe true Phenomena, yet it ſeems warrantable enough to argue from them, that there may be Agents ſo qualified, and ſo ſwiftly moved, that notwithſtanding their being ſo exceedingly minute, as they muſt be, to make up a flame, which is a fluid Body, they muſt in an imperceptible time pervade ſolid Bodies, and traverſing ſome of them without violating their Texture, burn, break, melt, and produce other very great changes in other Bodies that are fitted to be wrought on by them. And of this I muſt not forget to mention this remarkable inſtance; That a perſon Curious enough to collect many rarities, bringing me one day into the Study where he kept the choiceſt of them, I ſaw there among other things a fine pair of Drinking-glaſſes that were ſomewhat ſlender, but extraordinarily tall; they ſeem'd to have been

been designed to resemble one another, and made for some drinking entertainment. But before I saw them, that resemblance was much lessen'd by the Lightning, that fell between them in so strange a manner, that, without breaking either of them, that I could perceive, it alter'd a little the figure of one of them, near the lower part of the Cavity; but the other was so bent near the same place as to make it stand quite awry, and give it a posture, that I beheld not without some amazement. And I cannot yet but look upon it as a very strange thing, and no less considerable to our present purpose, that Nature should in the free Air make of Exhalations, and that such as probably when they ascended were invisible, such an aggregate of Corpuscles, as should without breaking such frail Bodies as Glasses, be able in its passage thorow them, that is, in the twinkling of an Eye, to melt them; which to do is wont even in our Reverberatory Furnaces to cost the

the active flames a pretty deal of time.

And this calls into my memory, that upon a time, hearing not far off from me ſuch a clap of Thunder as made me judge and ſay, that queſtionleſs ſome of the neighbouring places were thunder-ſtrook, I ſent preſently to make inquiry; which having juſtified my conjecture, I forthwith repaired to the houſe, where the miſchief was done, by ſomething, which thoſe, that pretended to have ſeen it coming thither, affirm'd to be like a flame moved very obliquely. To omit the hurt, that ſeemed to have been done by a Wind that accompanied it, or was perhaps produced by it, to divers perſons and cattel; that which makes me here mention it, was, that obſerving narrowly what had happen'd in an upper room, where it firſt fell, I ſaw, that it had in more than one place melted the Lead in its paſſage, (though that poſſibly outlaſted not the twinkling of an Eye,) without breaking to

pieces

pieces the glass-casements, or burning (that I took notice of) either the Bed or Hangings or any other combustible houshold-stuff; though near the window it had thrown down a good quantity of the solid substance of the Wall, through which it seem'd to have made its passage in or out. And that, which made me the less scruple to mention this accident, is, that having curiously pry'd into the Effects of the *Fulmen*, not only in that little upper room, but in other parts of the House, beneath whose lowermost parts it seem'd to have ended its extravagant course, I could not but conclude, That if so be it were the same *Fulmen*, it must have more than once gone in and out of the House, and that the line of its motion was neither straight, nor yet reducible to any curve or mixed line, that I had met with among Mathematicians; but that, as I then told some of my Friends, it moved to and fro in an extravagant manner, not unlike the irregular and wrigling motion of those

those fired Squibs that Boys are wont to make by ramming Gunpowder into Quills. But about Thunder more perhaps elsewhere. I shall here only add, That whereas 'tis a known Tradition, which my own Observations heedfully made seem now and then to confirm, that vehement Thunder, if Beer be not very strong, will usually (for I do not say alwayes) sowre it in a day or two; if this degeneration be not one of the consequences of the great and peculiar kinds of the concussions of the Air that happens in lowd Thunder (in which case the Phenomenon will belong to the next Discourse,) the effect may probably be imputed to some subtile Exhalations diffused thorow the Air, which, penetrating the pores of the Wooden vessels, whose contexture is not very close, imbue the liquor with a kind of acetous Ferment; which conjecture I should think much confirmed by a tryal, it suggested to me, if I had made it often enough to rely upon it. For considering that the pores

pores of Glaſs are ſtraight enough to be impervious (for ought I have yet obſerved) to the Steams or ſpirituous parts of Sulphur as well as to other odorous Exhalations, I thought it worth trying, whether there be any ſulphureous Steams or other Corpuſcles diffuſed thorow the Air in time of Thunder, that would not be too groſs to get in at ſuch minute pores as thoſe of Glaſs. And accordingly having Hermetically ſealed up both Beer and Ale apart, I kept them in Summer time till there happen'd a great Thunder, a day or two, after which the Beer which we drank, that was good before, being generally complained of as ſowred by the Thunder, I ſuffer'd my liquors to continue at leaſt a day or two longer, that the ſowring Steams, if any ſuch there were, might have time enough to operate upon them, and then breaking the Glaſſes, I found not that the liquors had been ſowred, though we had purpoſely forborn to fill the Glaſſes, to facilitate the degeneration of the

the liquors. Perhaps it will be pardonable on this occasion to mention a practice, which is usual in some places where I have been, and particularly employ'd by a great Lady, that is a great house-keeper, and is very curious and expert in divers Physical Observations; for, talking with her about the remedies of the Sowring of Beer and other drinks by Thunder, which is sometimes no small prejudice to her, she affirm'd to me, that she usually found the practice, I was mentioning, succeed: And that before the then last great Thunder, of which I had observed the Effects upon Beer, she preserved hers by putting, at a convenient distance, under the Barrels, Chaffing-dishes of Coals, when she perceiv'd that the Thunder was like to begin, which practice, if it constantly succeed, may put one a considering, whether the Fire do not by rarifying the Air and discussing the sulphureous or other Steams, by altering them, or by uniting with them the Exhalations

of

of the Coals, or by some such kind of way, render ineffectual these sowring Corpuscles, which perhaps require a determinate bulk and shape, besides their being crowded very many of them together, to have their full Operation on Barrell'd Liquors. But these things are but meer Conjectures, and therefore I proceed.

CHAP. VI.

THE fifth way whereby Effluviums may perform notable things, is the Motion of one part upon another, that they may excite or occasion in the Body they work on according to its structure.

I shall in the following Tract have occasion to say something of the Motions into which the Internal parts of Inanimate Bodies may put one another; but the Examples now produced are designed to manifest the Efficacy, that Effluviums may, on the newly

newly mentioned accounts, have on Organical and living Bodies. To which Instances it would yet be proper to premise, That even Inanimate and Solid Bodies may be of such a structure as to be very much alterable by the appropriated Effluviums of other Bodies, as may be instanc'd in the power, that I have known some vigorous Loadstones to have, of taking away in a trice the attractive virtue of an excited Needle, or giving a verticity directly contrary to the former without so much as touching it.

And we may pertinently take notice of the attractive virtue of the Loadstone, as that, which may afford us an eminent Example of the great power of a multitude of invisible Effluviums, even from Bodies that are not great, upon Bodies that are Inorganical or liveless: For taking it for granted, what both the *Epicureans*, *Cartesians*, and almost all other Corpuscularian Philosophers agree in, that Magnetism is performed by corporeal Emissions, we may consider, that

that these passing unresistedly thorow the pores of all solid Bodies, and even Glass it self, which neither the subtilest Odours nor Electrical Exhalations are observ'd to do, seem to be almost incredibly minute, and much smaller than any other Effluviums, though themselves too small to be visible; and yet these so incomparably little Magnetical Effluxions proceeding from vigorous Loadstones, will be able to take up considerable quantities of so ponderous a Body as Iron; in so much that I have seen a Loadstone not very great, that would keep suspended a weight of Iron, that I could hardly lift up to it with one Arm; and I have seen a little one, with which I could take up above eighty times its weight. And these *Effluvia* do not only for a moment fasten the Iron to the Stone, but keep the Metal suspended as long as one pleases.

This being premised, I come now to observe, That the chief effects of *Effluvia* belonging to the fifth Head

are wrought upon Animals, which by virtue of their curious and elaborate ſtructure, have their parts ſo connected and otherwiſe contrived, that the motions or changes that are produced in one, may have by the conſent of Parts a manifeſt operation upon others, although perhaps very diſtant from it, and ſo fram'd as to declare their being affected by actions that ſeem to have no affinity at all with the Agents that work upon the part firſt affected.

I have ſhewn at large in another * Treatiſe, that a Humane Body ought not to be look'd upon meerly as an aggregate of Bones, Fleſh, and other conſiſtent parts; but as a moſt curious and a living Engin, ſome of whoſe parts, though ſo nicely fram'd as to be very eaſily affected by external Agents, are yet capable of having great Operations upon the other parts of the Body, they help to compoſe. Wherefore without now repeating what is there already deliver'd,

* *The Uſefulneſs of* Experimental Philoſophy.

liver'd, I ſhall proceed to deliver ſuch Effects as are wrought on Human Bodies by theſe Effluviums without any immediate contact of the Bodies that emit them.

And firſt, not to mention *Light*, becauſe its being or not being a Corporeal thing is much diſputed even among the Moderns; 'tis plain, that our organs of Smelling are ſenſibly affected by ſuch minute Particles of matter as the fineſt odours conſiſt of. Nor do they alwayes affect us preciſely as odours, ſince we ſee, that many perſons, both men and women, are by Smells, either ſweet or ſtinking, put into troubleſom Headaches.

If it were not almoſt ordinary, it would be more than almoſt incredible, that the ſmell of a pleaſing Perfume ſhould preſently produce in a Human Body, that immediately before was well and ſtrong, ſuch faintneſſes, ſwoons, loſs of ſenſible reſpiration, intumeſcence of the *Abdomen*, ſeeming Epilepſies, and really convulſive motions of the Limbs, and

I know not how many other frightful Symptoms, that by the unskilful are often taken for the effects of Witchcraft, and would impose upon Physicians themselves, if their own or their Predecessors Experience did not furnish them with Examples of the like *Phænomena* produc'd by Natural means. Those Symptoms manifest, what the consent of Parts may do in a Humane Body; since even Morbifick Odours, if I may so call them, by immediately affecting the organs of Smelling, affect so many other parts of the *genus Nervosum*, as oftentimes to produce Convulsive motions, even in the extreme parts of the Hands and Feet.

Nor is the efficacy of Effluviums confined to produce Hysterical fits, since these invisible Particles may be able (and sometimes as suddenly as Perfumes are wont to excite them) to appease them, as I have very frequently, though not with never-failing success, tryed; by holding a Spirit, I usually make of *Sal Armoniack*,

niack, under the Noſtrils of Hyſterical perſons. My remedy did not only often recover, in a trice, thoſe whoſe Fits were but ordinary, but did more than once, ſomewhat to the wonder of the By-ſtanders, relieve, within a Minute or two, perſons of differing Ages and Conſtitutions, that were ſuddenly fallen down by Fits, that the By-ſtanders judg'd *Epileptical*, (but I, *Hyſterical.*)

I attribute the good and evil Operations of the fore-mentioned Steams, rather in general to the conſent of the parts that make up the *genus Nervoſum*, than to any hidden Sympathy or Antipathy betwixt them and the Womb, not only for other reaſons, not proper to be inſiſted on here, but becauſe I have known Odours have notable Effects even upon Men. I know a very eminent perſon, a Traveller, and a man of a ſtrong conſtitution, but conſiderably Sanguine, who is put into violent Head-aches by the Smell of Musk. And I remember, that one day being

with him and a great many other men of note about a Publick Affair, a man that had a parcel of Musk about him, having an occaſion to make an application to us, this perſon was ſo diſordered by the ſmell, which to moſt of us was delightful, that in ſpight of his Civility he was reduc'd to make us an Apology, and ſend the perfumed man out of the room, notwithſtanding whoſe receſs this perſon complained to me, a good while after, of a violent pain in his Head, which I perceived had ſomewhat unfitted him for the Tranſaction of the Affair whereof he was to be the chief manager. I know another perſon, whoſe happy Muſe hath juſtly made him many Admirers, that is ſubject to the Head-ach upon ſo mild a ſmell as that of Damask-Roſes, and ſometimes even of Red-Roſes, in ſo much that walking one day with him in a Garden, whoſe Alleys were very large, ſo that he might eaſily keep himſelf at a diſtance from the Buſhes, which bore many of them Red-Roſes; he

he abruptly broke off the diſcourſe we were engag'd in, to complain of the harm the Perfume did his Head, and deſired me to paſs into a Walk, that had no Roſes growing near it.

If it were not for the Sex of this perſon, I could relate an Inſtance that would be much more conſiderable of the Operation of Roſes. For I know a diſcreet Lady to whom their ſmell is not *unpleaſing*, (for ſhe anſwer'd me that 'twas not ſo at all,) but ſo *hurtful*, that it preſently makes her ſick, and would make her ſwoon if not ſeaſonably prevented: And ſhe told me that being once at a Court in which ſhe was a Maid of Honour, though ſhe her-ſelf did not know whence it came, ſhe found her ſelf extremely ill on a ſudden, and ready to ſink down for faintneſs; but being then in diſcourſe with a perſon, whoſe High Quality ſhe payd her profound reſpect to, her Civility, that kept her from complaining or withdrawing, might have been dangerous if not fatal to her, had not the Princeſs

who was ſpeaking with her, and who knew her Antipathy to Roſes, taken notice that her Face grew ſtrangely pale, and was covered with a cold ſweat. For thereby preſently gueſſing what might be the cauſe, which the ſick Lady her ſelf did not, ſhe asked aloud whether ſome body had not brought Roſes (which were then in ſeaſon) into the Bed-chamber, which queſtion occaſioned a ſpeedy withdrawing of a Lady, that ſtood at a diſtance off, and had about her Roſes, which were not ſeen by the Patient, who was by this means preſerved from falling into a ſwoon, though not from being for a while very much diſcompoſed.

But this you may tell me was the caſe of a *Woman*, who complain'd her malady affected her Heart, not her Head. Wherefore returning to what I was ſpeaking of before I mention'd Her, I ſhall proceed to tell you, that as Odours may thus give Men the Head-ach, ſo I have often found the ſmell of rectified Spirit of *Sal Armoniack*

to

to free Men as well as Women from the Fits of that diſtemper; and that ſometimes in ſo few Minutes, that the perſons reliev'd could ſcarcely imagine, they could ſo quickly be ſo.

To which I ſhall not add the Tryals that I have ſucceſsfully made upon my ſelf, becauſe being, thanks be to God, very ſeldom troubled with that diſtemper, the occaſions I have had of making them have not been many. And though I have not *alwayes* found ſo ſlight a Remedy to work the deſired Cure, yet that it does it often, even in Men, is ſufficient to ſhew the Efficacy of Sanative Effluviums.

Now, to manifeſt, that Steams do not Operate only upon Hyſterical Women, or perſons ſubject to the Head-ach, I will add ſome Inſtances of the Effects they may produce upon other perſons, and parts.

'Tis but too well known an Obſervation, that Women with Child have been often made to miſcarry by the ſtink of an ill-extinguiſht Candle, though

though perhaps the ſmoak aſcending from the Snuff were diſſipated into the inviſible Corpuſcles, a good while before it arriv'd at the Noſtrils of the unhappy Woman; and what violent and ſtraining motions Abortions are frequently accompanied with, is ſufficiently known already.

I think I have elſewhere mentioned, that a Gentleman of my acquaintance, a proper and luſty man, will be put into the fits of Vomiting by the ſmell of Coffee, boyl'd in Water; I ſhall therefore rather mention, that I know a Phyſician, who having been, for a long time when he was young, frequently compelled to take *Electuarium lenitivum*, one of the gentleſt and leaſt unpleaſant Laxatives of the Shops, conceived ſuch a diſlike of it, that ſtill, as himſelf has complained to me, if he ſmell to it, as he ſometimes happens to do in Apothecaries Shops, it will work (now and then for ſeveral times) upwards and downwards with him.

I know another very ingenious perſon

perſon of the ſame faculty, that has been a Traveller by Sea and Land, who has complain'd to me, that the ſmell of the Greaſe of the Wheels of a Hackney-coach, though it do but paſs by him, is wont to make him ſick and ready to Vomit.

Every body knows, that Smoak is apt to make mens Eyes water, and excite in the organs of Reſpiration that troubleſom and vehement commotion we call Coughing. But we need not have recourſe at all to viſible Fumes, for the production of the like Effects; ſince we have often obſerved them, and repeated Sneezings to boot, to proceed from the inviſible Steams of Spirit of *Sal Armoniack*, when Vials containing that liquor, though they were perhaps but very ſmall, were approached too haſtily, or perhaps too near to the Noſtrils.

And becauſe in moſt of the foregoing Inſtances, the chief Effects ſeem to be wrought, by the conſent of parts, on the *genus Nervoſum* and the action of one of them upon the other,

other, and thereby upon ſeveral other parts of the Body, I will ſubjoyn a remarkable inſtance of the Operation of a mild and grateful Odour upon the Humors themſelves, and that in a Man.

A famous Apothecary, who is a very tall and big man, ſeveral times told me, that though he was once a great lover of Roſes, yet having had occaſion to employ great quantities of them at a time, he was ſo altered by their Steams, that now, if he come among the Roſe-buſhes, the ſmell does much diſcompoſe him. And the odour of Roſes, (I mean Incarnate-Roſes, which we commonly call Damask-Roſes, though they be not the true ones,) makes ſuch a colliquation of Humors in his Head, that it ſets him a coughing, and makes him run at the Noſe, and gives him a ſore throat; and by an affluence of Humors makes his Eyes ſore, in ſo much that during the ſeaſon of Roſes, when quantities of them are brought into his Houſe, he is oblig'd for

for the moſt part to abſent himſelf from home.

CHAP. VII.

ONE may ſhew on this occaſion, that as there might be conſiderable things performed by Effluviums, as they make one part of a living Engine work upon another by virtue of its ſtructure, ſo the action of ſuch inviſible Agents may in divers caſes be much promoted by the fabrick and laws of the Univerſe it ſelf, upon this account, that, by the Operation of *Effluvia* upon particular Bodies, they may diſpoſe and qualifie thoſe Bodies to be wrought upon, which before they were not fit to be, by Light, Magnetiſms, the Atmoſphere, Gravity or ſome other of the more Catholick Agents of Nature, as the World is now conſtituted. But not to injure another Tract, I ſhall conclude this, when I ſhall have taken notice,

notice, that in the Instances hitherto produced, there has been a visible Local distance between the Body that emits Steams, and that on which they work. But if I thought it necessary, it were not difficult to shew, that one might well enough referr to the title of this Tract divers Effects of Bodies that are applied immediately to ours; such as are Blood-stones, Cornelions, Nephritick-stones, *Lapis Malacensis*, and some Amulets, and other solid substances applied by Physicians outwardly to our Bodies. For in these applications the gross Body touches but the Skin, and the great Effects, which I elsewhere relate my self to have sometimes (though not often, much less alwayes) observed to have followed upon this External contact or near application, may reasonably be derived from the subtle Emanations, that pass thorow the Pores of the Skin to the inward parts of the Body: As is evident in those, who by holding *Cantharides* in their Hands, or having them apply'd

to

to ſome remote External part, have grievous pains produc'd in their Urinary parts, as it has happen'd to Me as well as to many others. And to the inſinuation of theſe minute Corpuſcles, that get in at the Pores of the Skin, ſeems to be due the Efficacy of ſome Medicines, that purge, vomit, reſolve the Humors, or otherwiſe notably alter the Body being but externally applied; of which I could here give ſeveral Inſtances, but that they belong more properly to another place, and are not neceſſary in this, where it may ſuffice to name the notorious Power, that Mercurial Oyntments or Fumes, either together or apart, have of producing Copious Salivations, to ſhew in general, that both the Steams and the Emanations of outwardly applied Medicinal Bodies may have ſome great Effects on Human ones.

OF THE Determinate Nature OF EFFLUVIUMS.

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OF THE DETERMINATE NATURE OF *EFFLUVIUMS.*

CHAP. I.

THE Effluviums of Bodies, *Pyrophilus,* being for the moſt part inviſible, have been wont to be ſo little conſider'd by vulgar Philoſophers, that ſcarce vouchſafing to take notice of their Exiſtence, 'tis no wonder that men have not been ſolicitous to diſcover their diſtinct Natures and Differences. Only * *Ariſtotle,* and (upon his account) the Schools, have been pleaſed to think,

* *Lib.* 1. *Meteor. cap.* 3, & 4.

think, that the two grand parts of our Globe do ſometimes emit two kinds of Exhalations or Steams; the *Earthy* part affording thoſe that are hot and dry, which they name *Fumes*, and very often, ſimply, *Exhalations*; and the *Aqueous* part, others that are (not as many of his Diſciples miſtake him to have taught, Cold and Moiſt, but) Hot and Moiſt*, which they uſually call *Vapours*, to diſcriminate them from the Fumes (or Exhalations,) though otherwiſe, in common acceptation, thoſe Appellations are very frequently confounded.

* Cap. 3. Ἔστι μὲν ἀτμὶς θερμὸν ὑδατώδης φύσις, ὑγρὸν καὶ θερμόν.

But, though the *Ariſtotelians* have thus perfunctorily handled this Subject, it would not become Corpuſcularian Philoſophers, who attribute ſo much as they do to the Inſenſible Particles of Matter, to acquieſce in ſo ſlight and jejune an account of the Emanations of Bodies. And ſince we have already ſhewn, that beſides the greater and more ſimple Maſſes

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of Terreſtrial and Aqueous matter newly mention'd, there are very many mixt Bodies, that emit Effluviums, which make, as it were, little Atmoſpheres about divers of them, it will be congruous to our Doctrine and Deſign, to add in this place, That beſides the ſlight and obvious differences, taken notice of by *Ariſtotle*, the Steams of Bodies may be almoſt as various as the Bodies themſelves that emit them; and that therefore we ought not to look upon them barely under the general and confuſed notion of Smoak or Vapours, but may probably conceive them to have their diſtinct and determinate Natures, oftentimes (though not always) ſuitable to that of the Bodies from whence they proceed.

And indeed the newly mentioned Diviſion of the *Schools* gives us ſo ſlight an account of the Emanations of Bodies, that, methinks, it looks like ſuch another, as if one ſhould divide Animals into thoſe that are *Horned*, and thoſe that have *Two Feet*:

For, beſides that the Diſtinction is taken from a Difference that is not the conſiderableſt, there are divers Animals (as many four-footed Beaſts and Fiſhes) that are not compriſed in it; and each member of the Diviſion comprehends I know not how many diſtinct ſorts of Animals, whoſe differences from one another are many times more conſiderable, than thoſe that conſtitute the two ſupreme *Genus's*, the one having Bulls and Goats, and Rhinoceros's, and Deer, and Elks, and certain Sea-Monſters whoſe Horns I have ſeen; and the other *Genus* compriſing alſo a greater Variety, namely, a great part of Four-footed Beaſts, and, beſides Men, all the Birds (for ought we know) whether of Land or Water. And as it would give us but a very ſlender Information of the Nature of an Elk or an Unicorn, to know that 'tis an *Horned* Beaſt; or of the Nature of a Man, an Eagle, or a Nightingale, to be told, that 'tis an *Horn-leſs* Beaſt; ſo it will but very little inſtruct a man

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in the Nature of the Steams of *Quick-ſilver* or of *Opium*, to be told, that they are Vapours Hot (or rather Cold) and Moiſt; or of the Steams of *Amber* or *Cantharides*, or *Cinnamon*, or *Tobacco*, to be told, that they are Hot and Dry. For, beſides that there may be Effluviums, which, even by their Elementary Qualities, are not of either of theſe two ſupreme *Genus's*, (for they may be Cold and Dry, or Cold and Moiſt,) theſe Qualities are often far from being the Nobleſt, and conſequently thoſe that deſerve to be moſt conſider'd in the Effluviums of this, or that, Body; as we ſhall by and by have occaſion to manifeſt.

Chap. II.

And here it may not be improper to mention an Experiment, that, I remember, I divers years ſince

employed to illuſtrate the Subject of our preſent Diſcourſe.

I conſider'd then, that Fluid Bodies may be of very unequal denſity and gravity, as is evident in Quick-ſilver, Water and pure Spirit of Wine; which, notwithſtanding their great difference in ſpecifick gravity, may yet agree in the conditions requiſite to Fluid Bodies. Therefore preſuming, that by what I could make appear viſible in one, what happens analogically in the other, may be ocularly illuſtrated, I took ſome Ounces of Roch-allom, and as much of fine Salt-peter. I took *ſome Ounces* of each, becauſe, if the quantity of the ingredients be too ſmall, the concoagulated grains will be ſo too, and the ſucceſs will not be ſo conſpicuous. Theſe being diſſolved together in fair Water, the filtrated ſolution was ſet to evaporate in an open-mouthed Glaſs, and being then left to ſhoot in a cool place, there were faſtned to the ſides and other parts of the Glaſs ſeveral ſmall Cryſtals, ſome Octoedrical, which

which is the figure proper to Roch-allom, and others of the Priſmatical ſhape of pure Salt-peter; beſides ſome other Saline concretions, whoſe being diſtinctly of neither of theſe two ſhapes, argued them to be concoagulations of both the Salts. And this we did by uſing ſuch a degree of Celerity in Evaporating the liquor, as was proper for ſuch an effect. For, by another degree, which is to be employ'd when one would recover the Salts more diſtinctly and manifeſtly, the matter may (as I found by tryal) be ſo ordered, that the aluminous Salt may, for the moſt part, be firſt coagulated by it ſelf, and then from the remaining liquor curiouſly ſhap'd Cryſtals of Nitre may be copiouſly obtained.

Tryals like this we alſo made with other Salts, and particularly with Sea-Salt, and with Allom and Vitriol; the *Phænomena* of which you may meet with in their due places. For the recited Experiment may, I hope, alone ſerve to aſſiſt the imagination

to

to conceive, how the Particles of Bodies may ſwim to and fro in a Fluid, (which the Air is,) and though they be little enough to be inviſible, may many of them retain their diſtinct and determinate natures, and their aptneſs to cohere upon occaſion; and others may, by their various occurſions and coalitions, unite into leſſer Corpuſcles or greater Bodies differing from the more ſimple Particles, that compoſed them, and yet not of indeterminate though compounded Figures.

Chap. III.

These things being premis'd, we may now proceed to the particular Inſtances of the Determinate Nature of Effluviums; and theſe we may not inconveniently reduce to the three following Heads, to each of which we ſhall aſſign a diſtinct Chapter; the firſt of theſe I ſhall briefly

briefly treat of in this third Chapter, and treat ſomewhat more largely of the others in the two following.

In the firſt place then, That the Effluviums of many Bodies retain a determinate Nature oftentimes in an inviſible ſmallneſs, and oftener in ſuch a ſize as makes them little enough to fly or ſwim in the Air; may appear by this, that theſe *Effluvia* being by Condenſation or otherwiſe reunited, they appear to be of the ſame nature with the Body that emitted them. Thus in moiſt weather, the Vapours of Water, that wander inviſibly through the Air, meeting with Marble-Walls or Pavements, or other Bodies, by their Coldneſs and other Qualifications, fit to condenſe and retain them, appear again in the form of Drops of Water; and the ſame Vapours return to the viſible form of Water, when they fall out of the Air in Dews, or Rains.

Quickſilver it ſelf, if it be made to aſcend in diſtillation with a convenient degree of Fire, will almoſt all be

be found again in the Receiver in the form of running Mercury. Which ſtrange and piercing Fluid, is in ſome caſes ſo diſpoſed to be ſtrip'd of its Diſguiſes, and re-appear in its own form, that divers Artificers, and eſpecially Gilders, have found, to their coſt, that the fumes of it need not be, as in Diſtillation, included in cloſe Veſſels to return to their priſtine nature, Mercury having been ſeveral times found in the Heads and other parts of ſuch People, who have in tract of time been killed by it, and ſometimes made to diſcover it ſelf during the Lives of thoſe that dealt ſo much in it; of which I elſewhere give ſome Inſtances. Wherefore I ſhall only obſerve at preſent, that 'tis a common Practice, both among Gilders, and ſome Chymiſts, that, when they have occaſion to make an Amalgam, or force away the Mercury from one by the fire, they keep Gold in their Mouthes, which by the Mercurial fumes, that wander through the Air, will now and then,

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by that time 'tis taken out of their Mouths, be turned white almoſt, as if it had been ſilver'd over.

A maſs of purified Brimſtone being ſublimed, the aſcending fumes will condenſe into what the Chymiſts call *Flores Sulphuris*, which is true Sulphur of the ſame nature with that, formerly expoſed to ſublimation; and may readily by melting be reduced into ſuch another maſs.

And to give you another like Example of dry Bodies; I tryed, that by ſubliming good Camphire in cloſe veſſels, it would all, as to ſenſe, be raiſed into the upper veſſel, or part of the Subliming-glaſs in the form of dry Camphire as it was before.

Nay though a Body be not by Nature, but Art compounded of ſuch differing Bodies as a Metal and another Mineral, and two or three Salts; yet, if upon Purification of the mixture from its groſſer parts, the remaining and finer parts be minute enough and fitly ſhap'd, the whole liquor will aſcend, and yet in the Receiver

Receiver altogether recover its priſtine form of a tranſparent Fluid, compoſed of differing Saline and Mineral parts. This is evident in the Diſtillation of what Chymiſts call *Butter*, or *Oyl* of Antimony, very well rectified. For, this Liquor will paſs into the Receiver diaphanous and fluid, though, beſides the Particles of the Sublimate, (which is it ſelf a factitious compounded Body) it abounds with Antimonial Corpuſcles, carried over and kept inviſible by the corroding Salts; whatever *Angelus Sala*, and thoſe Chymiſts that follow him, have affirm'd to the contrary; as might be eaſily here proved, if this were a fit place to do it in.

I found by inquiring of an Ingenious perſon, that had an intereſt in a Tin-Mine, that I was not deceived in gueſſing, that Tin it ſelf, though a Metal whoſe Ore is of a very difficult fuſion, and which I have by it ſelf kept long upon the Cupel without finding it to fly away, would yet retain its Metalline nature in the form

of

of fumes or flowers. For this experienc'd Gentleman answer'd me, that divers times they would take great store of a whitish Sublimate from the upper part of the Furnaces or Chimnies, where they brought their Ore to fusion, or wrought further upon it; and that this Sublimate, though perhaps elevated to the height of an ordinary Man, would, when melted down, afford at once many Pounds of very good Tin. On which occasion I shall add, that I have my self more than once raised this Metal in the form of white Corpuscles by the help of an Additament, that did scarce weigh half so much as it.

Chap. IV.

THe second way, by which we may discover the Determinate Nature of Effluviums, is, by the difference that may sometimes be observ'd in their Sensible Qualities. For, these

those Effluviums that are endow'd with them, proceed from the same sort of Bodies, and yet those afforded by one kind of Bodies being in many cases manifestly differing from those that fly off from another, this evident disparity in their Exhalations argues their retaining distinct natures, according to those of the respective Bodies whence they proceed.

I will not now stay to examine, whether in the Steams, that are made visibly to ascend from the Terrestrial Globe by those grand Agents and usual raisers of them, the Sun, and the agitation of the Air, the Eye can manifestly distinguish the diversity of colours: But in some productions of Art such different colours may be discovered in the Exhalations, even without the application of any external heat to raise them. For, when Spirit of Nitre, *for example*, has been well rectified, I have often observ'd, that even in the cold the fumes would play in the unfill'd part of the stop'd Vials it was kept in, and appear in it

it of a reddiſh colour, and, if thoſe veſſels were open'd, the ſame fumes would copiouſly aſcend into the Air, in the form of a reddiſh or orange-tawny Smoak. Spirit or Oyl of Salt alſo, if it be very well dephlegm'd, though it will ſcarce in the cold viſibly aſcend in the empty part of a Vial, whilſt it is kept well ſtop'd; yet, if the free Air be allow'd acceſs to it, it will, in caſe it be ſufficiently rectified, fly up in the form of a whitiſh fume. But this is inconſiderable in compariſon of what happens in a volatile Tincture of Sulphur, I have elſewhere taught you to make with Quick-lime. For, not only upon a ſlight occaſion the vacant part of the Vial will be fill'd with white fumes, though the Glaſs be well ſtop'd; but upon the opening the Vial theſe fumes will copiouſly paſs out at the neck, and aſcend into the Air in the form of a Smoak, more white than perhaps you ever ſaw any. And both this and that of the Spirit of Salt-peter do by their operation, as well as ſmell,

diſcloſe what they are; the latter being of a Nitrous nature, (as is confeſs'd) and the former, of a Sulphureous: In ſo much that having for curioſities ſake in a fitly ſhap'd Glaſs caught a competent quantity of the aſcending white fumes, I found them to have conven'd into Bodies tranſparent and Geometrically figur'd, wherein 'twas eaſie to diſcover by their ſenſible qualities, that there were ſtore of Sulphureous particles mixt with the Saline ones. That the liquors of Vegetables, diſtill'd *in Balneo* or in Water, are not wont to retain any thing of the colour of the Bodies that afforded them, is a thing eaſie to be obſerv'd in Diſtillations made without Retorts or the violence of the Fire. But it may be worth while to make tryal, whether the Eſſential Oyl of Wormwood aſcend colour'd like the Plant, whence 'tis firſt drawn over with Water in the Limbec, or rectified *in Balneo*. For, I forgot to take notice of it, when upon ſome particularities, I obſerv'd in that Plant,

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my curiosity led me to find, that not only in the first distillation in a Copper Limbec, tinn'd on the inside, the Oyl came over green, but by a rectification purposely made in a Glass-vessel, the purified liquor was not depriv'd of that colour.

The mention of these Essential Oyls, as Chymists call those that are drawn in Limbecs, leads me to tell you, that, though these liquors be but *Effluvia* of the Vegetables they are distill'd from, condens'd again in the Receiver into liquors; yet, as subtile as they are, many of them retain the genuine taste of the Bodies, whence the heat elevated them; as you will easily find, if you will tast a few drops of the Essential Oyl of Cinamon, *for example*, or of Wormwood dissolv'd by the intervention of Sugar or Spirit of Wine in a convenient quantity of Water, Wine, or Beer. For, by this means you have the natural taste of this Spice or Herb. And Wormwood is a Plant, whose *Effluvia* do so retain the nature of the Body that parts with

them, that I must not forbear to alledge here an Observation of mine, that may shew you, that 'tis possible, though not usual, that even without the help of the Fire the expirations of a Body may communicate its taste. For, among other things, that I had occasion to observe about some quantity of Wormwood laid up together, I remember, I took notice, and made others do the like, that coming into a room, where 'twas kept, not only the organs of smelling were powerfully wrought upon by the Corpuscles that swarm'd in the Air, but also the Mouth was sensibly affected with a bitter taste. Perhaps you will scarce think it worth while, that after this instance I should add, that I found the expirations of *Amber*, kept a while in pure Spirit of Wine, taste upon the tongue like Amber it self, when I chew'd it between my teeth. But I choose to mention this instance, because it will connect those lately mention'd with another sort, very pertinent to our present purpose. For, the

the expirations that I have obtain'd from Amber, both with pure Spirit of Wine, and a more piercing *Menſtruum*, did manifeſtly retain in both thoſe liquors a peculiar ſmell, with which I found it to affect the Noſtrils, when, for tryals ſake, I excited the Electrical faculty of Amber by rubbing. And as for Odours, 'tis plain, that the Eſſential Oyls of Chymiſts, well drawn, do many of them retain the peculiar and genuine ſent of the Spices or Herbs that afforded them. And that theſe Odours do really conſiſt of, or reſide in certain inviſible Corpuſcles that fly off from the viſible Bodies, that are ſaid to be endow'd with ſuch Smells, I have elſewhere prov'd at large; and it may ſufficiently appear from their ſticking to divers of the Bodies they meet with, and their laſting adheſion to them.

Other Examples may be given of the ſetled difference of Effluviums directly perceivable by Humane Organs of Senſe, as dull as they are;

which laſt expreſſion I add, becauſe I ſcarce doubt, but that, if our Senſories were ſufficiently ſubtile and tender, they might immediately perceive in the ſize, ſhape, motion, and perhaps colour too of ſome now inviſible Effluviums, as diſtinguiſhable differences, as our naked Eyes in their preſent conſtitution ſee, between the differing ſorts of Birds, by their appearances, and their manner of flying in the Air, as Hawks, and Partridges, and Sparrows, and Swallows. To make this probable I will not urge, that in fine white Sand, whoſe grains by the unaſſiſted Eye are not wont to be diſtinguiſhed by any ſenſible Quality, I have often obſerv'd in an excellent Microſcope, a notable diſparity as to bulk, figure, and ſometimes as to colour: And that in ſmall Cheeſe-mites, which the naked Eye can very ſcarcely diſcern, ſo far is it from diſcovering any difference between them, one may (as was noted in the laſt eſſay) plainly ſee, beſides an obvious difference in point of bigneſs,

many

many particular parts, on whose accounts the ſtructure of thoſe *moving points* may difference them from each other. And I have ſometimes ſeen a very evident diſparity even in point of ſhape between the very Eggs of theſe *living Atoms*, (as a Poet would perhaps ſtile them.) But theſe kinds of proofs (as I was ſaying) I ſhall forbear to inſiſt on, that I may proceed to countenance my conjecture by the effects of the Effluviums, that are properly ſo call'd, upon Animals.

And firſt, though the Touch be reckon'd one of the moſt dull of the five Senſes, and be reputed to be far leſs quick in Men than in divers other Animals; yet the groſs Organs of that, may, in Men themſelves, even by accident, be ſo diſpos'd, as to be ſuſceptible of impreſſions from *Effluvia*: Of this in another Paper I give ſome Inſtances. And I know not whether divers of the Preſages of Weather to be obſerv'd in ſome Animals, and the Aches and other pains, that, in many crazy and wounded

men, are wont to fore-run great changes of Weather, do not often (for I do not say alwayes) proceed (at least in part) from invisible and yet incongruous Effluxions, which, either from the subterraneal parts, or from some Bodies above ground, do copiously impregnate the Air. And on this occasion it will not be impertinent to mention here what an experienc'd Physician being (if I much misremember not) the Learned *Dimmerbrook*, relates concerning himself, who having been infected with the Plague by a Patient that lay very ill of it, though by Gods blessing, which he particularly acknowledges, upon a slight but seasonable Remedy, he was very quickly cured, and that without the breaking of any Tumor; yet it left such a change in some parts of his Body, that he subjoyns this memorable passage; *Ab illo periculo ad contagiosos mihi appropinquanti in emunctoriis successit dolor, vix fallax Pestis indicium.*

Two or three other Observations of

of the like nature you meet with in another of my Papers *. And I ſhall now add, that I know an ingenious Gentlewoman (Wife to a famous Phyſician) who was of a very curious and delicate complexion, that has ſeveral times aſſur'd me, that ſhe can very readily diſcover, whether a perſon, that comes to viſit her in Winter, came from ſome place where there is any conſiderable quantity of Snow; and this ſhe does, (as ſhe tells me) not by feeling any unuſual cold (for if the ground be frozen but not cover'd with Snow, the Effect ſucceeds not,) but from ſome peculiar impreſſion, which ſhe thinks, ſhe receives by the organs of Smelling. I might add, that I know alſo (as I may have formerly told you) a very ingenious Phyſician, who falling into an odd kind of Feaver, had his ſenſe of Hearing thereby made ſo very nice and tender, that he very plainly heard ſoft whiſpers, that were made at a conſiderable diſtance off, and which were not

* *About* Coſmical Suſpitions.

not in the leaſt perceiv'd by the healthy by-ſtanders, nor would have been by him before his ſickneſs. Which (ſickneſs) I mention as the thing, that gave his organs of Hearing this preternatural quickneſs, becauſe when the Feaver had quite left him, he was able to hear but at the rate of other men. And I might tell you too, that I know a Gentleman of eminent parts and note, who, during a diſtemper he had in his Eyes, had his organs of Sight brought to be ſo tender, that both his friends and himſelf alſo have aſſur'd me, that when he wak'd in the Night he could for a while plainly ſee and diſtinguiſh Colours, as well as other objects, diſcernable by the Eye, as was more than once try'd, by pinning Ribbands or the like Bodies of ſeveral colours, to the inſide of his Curtains in the dark. For if he were awaken'd in the Night, he would be able to tell his bed-fellow, where thoſe Bodies were plac'd, and what colour each of them was of.

I have

I have mention'd these Instances only to shew you, that if our Sensories were more delicate and quick, they would be sufficiently affected by Objects, that, as they are generally constituted, make no impressions at all upon them. For otherwise I know, that the *Species* (as they call them) both of Sounds and Colours, are not held by many of the Moderns, (from whom in that I dissent not,) to be so much corporeal Effluxions, trajected through the *medium*, as peculiar kinds of Local Motion convey'd by it. Therefore I shall now confirm the conjecture I would countenance by the discrimination made by the organs of other Animals of such *Effluvia* as to us men are not only invisible but insensible. And therefore partly to strengthen what I deliver'd, and partly to confirm what I am now discoursing of, it will not be impertinent to subjoyn two or three Relations, that I had from persons of very good credit, whom I thought likely to make me no unsatisfactory returns

to

to my Queſtions about things they were very well vers'd in.

A perſon of Quality, to whom I am near allied, related to me, that to make a tryal, whether a young Blood-hound was well inſtructed, (or as the Huntſmen call it, *made*) he caus'd one of his Servants, who had not kill'd, or ſo much as touch'd any of his Deer, to walk to a Countrey-town, four Mile off, and then to a Market-town three Miles diſtant from thence; which done, this Nobleman did, a competent while after, put the Blood-hound upon the ſcent of the man, and caus'd him to be follow'd by a Servant or two, the Maſter himſelf thinking it alſo fit to go after them to ſee the event; which was, that the Dog, without ever ſeeing the Man he was to purſue, follow'd him by the ſcent to the above-mentioned places, notwithſtanding the multitude of Market-people that went along in the ſame way, and of Travellers that had occaſion to croſs it. And when the Blood-hound came to the chief

chief Market-town, he paſs'd through the ſtreets, without taking notice of any of the people there, and left not till he had gone to the Houſe, where the Man, he ſought, reſted himſelf, and found him in an upper Room to the wonder of thoſe that follow'd him. The particulars of this Narrative the Nobleman's Wife, a perſon of great veracity, that happen'd to be with him when the tryal was made, confirm'd to me.

Enquiring of a ſtudious perſon, that was Keeper of a Red-dear-park and vers'd in making Blood-hounds, in how long time, after a Man or Deer had paſs'd by a graſſy place, one of thoſe Dogs would be able to follow him by the ſcent? He told me, that it would be ſix or ſeven Hours: Whereupon an ingenious Gentleman, that chanc'd to be preſent, and liv'd near that Park, aſſur'd us both, that he had old Dogs of ſo good a ſcent, that if a Buck had the day before paſs'd in a Wood, they will, when they come where the ſcent lies, though

though at such a distance of time after, presently find the scent and run directly to that part of the Wood where the Buck is. He also told me, that though an old Blood-hound will not so easily fix on the scent of a single Deer, that presently hides himself in a whole herd; yet if the Deer be chas'd a little till he be heated, the Dog will go nigh to single him out, though the whole herd also be chas'd. The above-nam'd Gentleman also affirm'd, that he could easily distinguish whether his Hounds were in chase of a Hare or a Fox by their way of running, and their holding up their Nose higher than ordinary when they pursue a Fox; whose scent is more strong. These Relations will not be judg'd incredible by him that reflects on some of the Instances that have already (in the foregoing Essay) been given of the strange subtilty of *Effluvia*: To which I shall now add, that I remember, that to try whether I could in some measure make Art imitate Nature, I prepared a Body

of

of a vegetable ſubſtance, which, though it were actually cold, and both to the Eye and Touch dry, did for a while emit ſuch determinate and piercing, though inviſible, Exhalations, that having for Tryals ſake applied to it a clear Metalline Plate (and that of none of the very ſofteſt kind neither) for about one Minute of an Hour, I found, that, though there had been no immediate contact between them, I having purſpoſely interpoſed a piece of Paper to hinder it; yet there was imprinted on the ſurface of the Plate a conſpicuous ſtain of that peculiar colour, that the Body, with whoſe Steams I had imbued the vegetable ſubſtance, was fitted to give a Plate of that mix'd Metal. And though it be true, that in ſome circumſtances, the lately mention'd Inſtances about Blood-hounds have a conſiderable advantage of this I have now recited; yet that advantage is much leſſen'd, not to ſay countervail'd, by ſome circumſtances of our Experiment. For, not to repeat, that

that the emittent Body was firm and cold, the Effect produced by the Effluvium that guided the Setting-dog, was wrought upon the Senſory of a living and warm Animal; and ſuch an one, whoſe organs of Smelling are of an extraordinary tender Conſtitution above thoſe of Men and other Animals, and probably the Impreſſion was but tranſient; whereas in our caſe the inviſible Steams of the vegetable ſubſtance wrought upon a Body which was of ſo ſtrong and inorganical a Texture as a (compounded) Metal, though it were fenc'd by being lapt up in Paper, notwithſtanding which theſe Steams invaded it in ſuch numbers, and ſo notably, as to make their Operation on it manifeſt to the Eye, and conſiderably permanent too; ſince coming to look upon the Plate after the third day, I found the induced Colour yet conſpicuous, and not like ſuddenly to vaniſh.

Hitherto in this *Chapter* I have argued from the conſtant and ſetled

diffe-

difference of the ſenſible Qualities of Effluviums, that they do not always loſe their diſtinct natures, when they ſeem to have loſt themſelves by vaniſhing into Air. But before I diſmiſs this Subject, I muſt conſider an Objection, which I know may be made againſt the Opinion we have been countenancing. For it may be alledg'd, that there may be many caſes, wherein the Effluviums of Bodies are, in their paſſage through the Air, ſenſibly alter'd, or do affect the Organs of ſenſe otherwiſe than each kind of them apart would do: Nor is this difficulty altogether irrational. For it ſeems conſonant enough to Experience, that ſome ſuch caſes ſhould be admitted, and therefore in the foregoing Diſcourſe I have, where I thought it neceſſary, forborn to expreſs my ſelf in ſuch general and abſolute terms, as otherwiſe I might have done. But, as for ſuch caſes as I have inſiſted upon, and many more, I ſhall now repreſent, that the objected alterations need not hinder, but that

Effluviums at their first parting from the Bodies, whence they take wing (if I may so speak,) may retain as much of the nature of those Bodies, as we have ascribed to them; since the subsequent change may very probably be deduc'd from the combinations or coalitions of divers Steams associating themselves in the Air, and acting upon the Sensory, either altogether and conjointly, or at least so near it, that the Sense cannot perceive their Operations as distinct. This I shall elucidate, but not pretend to prove, by what happens in Sounds and Tasts. For if, by way of instance, in a Musical instrument, two strings tun'd to an eigth, be touch'd together, they will strike the Ear with a sound, that will be judg'd one, as well as pleasing, though each of the trembling strings make a distinct noise, and the one vibrates as fast again as the other. And if, into Oyl of Tartar *per Deliquium*, you drop a due proportion of Spirit of Nitre, and exhale the superfluous moisture,

the

the Acid and Alcalizate Corpuſcles, that were ſo ſmall as to ſwim inviſibly in thoſe liquors, will convene into Nitrous Concretions, whoſe taſt will be compounded of, but very differing from, both the taſts of the Acid and Tartareous Particles; which Particles may yet, for the moſt part, by a skilful Diſtillation, be divorc'd again. And ſo, if to a ſtrong ſolution of Pot-aſhes or Salt of Tartar you put as much in weight of *Sal Armoniack*, as there is of either of thoſe fixt Salts contain'd in the liquor; you may, beſides a ſubtil Urinous Spirit that will eaſily come over in the diſtillation, obtain a dry *Caput mortuum*, which is almoſt totally a compounded Salt, differing enough from either of the ingredients, eſpecially the Alcalizate, as well in Taſt as in ſome other Qualities: This Salt (free'd from its *faeces*) being that Diuretick Salt, I ſeveral years ago gave quantities of, to ſome Chymiſts and Phyſicians, from the moſt of whom I received great thanks, accompanied

with the (more acceptable) accounts of the very happy ſucceſs they had employed it with, though uſually but in a ſmall Doſe, as from ſix, eight or ten Grains to a Scruple. But this being mentioned only upon the by, I ſhall proceed to tell you, that, ſince I intimated to you already, that I would mention Examples of *Sounds* and *Taſts* only to illuſtrate what I had been delivering; I ſhall now add ſome Inſtances by way of Proof, of the Coalition and reſulting change of Steams in the Air. 'Tis eaſily obſervable in ſome Noſe-gays, where the differing Flowers happen to be conveniently mix'd, that in the ſmell afforded by it, at a due diſtance, the Odours of the particular Flowers are not perceiv'd, but the Organ is affected by their joynt-action, which makes on it a confuſed but delightful impreſſion. And ſo, when in a Ball of Pomander, or a perfum'd Skin, Muſk, and Amber, and Civet, and other ſweets are skilfully mix'd, the coalition of the diſtinct *Effluvia* of the ingre-

ingredients, that associate themselves in their passage through the Air, produce in the Sensory one grateful perfume, resulting from all those Odours. But if you take Spirit of fermented Urine and Spirit of Wine, both of them Phelgmatick, and mix them together, they will incorporate like Wine and Water, or any other such liquors, without affording any dry concretions. But if you expose them in a convenient Vessel but to the mild heat of a Bath or Lamp, the ascending Particles will associate themselves, and adhere to the upper part of the Glass in the form of a white but tender Sublimate, consisting both of Urinous and Vinous Spirits, associated into a mixture, which differs from either of the liquors, not only in Consistence, Tast and Smell, but in some considerable Operations performable by this odd mixture; which, this is not the place, to take further notice of. And if Spirit of Salt and Spirit of Nitre be, by Distillation, elevated in the form of Fumes,

ſo order'd as to convene into one liquor in the Receiver, this liquor will readily diſſolve crude Gold, though neither the Spirit of Nitre alone, nor that of Salt would do ſo.

And that you may have an ocular proof of the Poſſibility of the diſtinctneſs and ſubſequent Commixture of Steams in the Air; I ſhall now add an Experiment, which I long ſince devis'd for that purpoſe, and which I ſoon after ſhew'd to many curious perſons, moſt of whom appear'd ſomewhat ſurpriz'd at it. The Experiment was; that I took two ſmall Vials, the one fill'd with Spirit of Salt, but not very ſtrong, the other with Spirit of fermented Urine or of *Sal Armoniack* very well rectified: Theſe Vials being plac'd at ſome diſtance, and not being ſtop'd, each liquor afforded its own ſmell, at a pretty diſtance, by the Steams it emitted into the Air, but yet theſe Steams were inviſible. But when theſe Vials, (which ſhould be of the ſame ſize) came to be approach'd very

very near to each other, though not so, as to touch; *as* when the two liquors are put together in the form of liquors, they will notably act upon one another; *so* their respective Effluviums meeting in the Air, would, answerably to the littleness of their bulk, do the like, and, by their mutual occursions, become manifestly visible, and appear moving in the Air like a little portion of Smoak or of a Mist, which would quickly cease, if either of the Vials were remov'd half a Foot or a Foot from the other. And I remember, that, to add to the oddness of the *Phænomenon*, I sometimes made a drop of the Spirit of Salt hang at the bottom of a little stick of Glass or some other convenient Body, and held this drop thus suspended in the Orifice of a Vial that had Spirit of *Sal Armoniack* in it, and was furnish'd with a somewhat long neck; for by this means it happen'd, as I expected, that the ascending Urinous Particles, though invisible before, invading plentifully the

Acid ones of the drop, produced a notable Smoak, which, if the drop were held a little above the neck of the Glaſs, would moſt commonly fly upwards to the height of a Foot or half a Yard: But if the drop were held ſomewhat deep within the Cavity of the neck, a good part of the produced Smoak would oftentimes fall into the Cavity of the Vial, which was left in great part empty, ſometimes in the form of drops, but uſually in the form of a ſlender and ſomewhat winding ſtream of a white colour, that ſeem'd to flow down juſt like a Liquor from the depending drop, till it had reach'd the Spirit of *Sal Armoniack*; upon whoſe ſurface it would ſpread it ſelf like a Miſt. But this only upon the by. As for the main Experiment it ſelf, it may be, as I have found, ſucceſsfully try'd with other Liquors than theſe; but 'tis not neceſſary in this place to give an account of ſuch Tryals; though perhaps, if I had leiſure, it might be worth while to conſider, whether

theſe Coalitions of differing ſorts of Steams in the Air, and the Changes reſulting thence of their particular precedent Quantities, may not aſſiſt us to inveſtigate the cauſes of divers ſudden Clouds and Miſts, and ſome other Meteorological *Phænomena*, and alſo of divers changes that happen in the Air in reference to the coming in and ceaſing of ſeveral either Epidemical or contagious Diſeaſes, and particularly the *Plague*, that ſeem to depend upon ſome occult temperature and alterations of the Air, which may be copiouſly impregnated by the differing ſubterraneal (not to add here, Sidereal) Effluviums, that not unfrequently aſcend into it (or otherwiſe invade it,) with Peſtiferous or other Morbifick Corpuſcles, and *ſometimes* with others of a contrary Nature, and *ſometimes* too perhaps, neither the one ſort of Steams, which may be ſuppos'd to have imbued the Air, is in it ſelf *deleterious*; nor the other *ſalutary*, but becomes ſo upon their caſual coalition in the Air. You will

will perhaps think this Conjecture of the resultancy of pestilential Steams, the less improbable, if I here add that odd Observation, which was frequently made in the formerly mentioned Plague at *Nimmegen* by a Physician so Judicious as * *Dimmerbrook*, whose words are these; *Illud notatu dignum sæpissimè observavimus, nempe in illis ædibus in quibus nulla adhuc pestis erat, si linteamina sordida aquâ & sapone nostrate (ut in Belgio moris est) illic lavarentur, eo ipso die, vel interdum postridie, duos tres-ve simul peste correptos fuisse, ipsique ægri testabantur fœtorem aquæ saponatæ illis primam & maximam alterationem intulisse. Hoc ipsum quoque in meo ipsius hospitio infelix experientia docuit, in quo post lota linteamina statim gravem alterationem perceperunt plærique domestici, & proximè sequenti nocte tres peste correptæ, ac brevi post mortuæ fuere.* I omit the Instances he further sets down to confirm this odd *Phænomenon*, of which, though perhaps some other

* *Tract. de Peste, lib. 2. cap. 3.*

other Cauſe may be deviſed, yet that I lately aſſign'd ſeems at leaſt a probable one, if not the moſt probable; ſince, as 'tis manifeſt by daily experience, that the ſmell occaſion'd by the waſhing of foul Linnen with the Soap commonly uſed in the *Netherlands*, produces not the Plague; ſo by our Learned Author's Obſervation it appears, either that there were not yet any Peſtilential Effluxions in the Air of thoſe places, which on the occaſions of thoſe waſhings became infected, or at leaſt that by the addition of the fetid *Effluvia* of the ſoapy Water, thoſe Morbifick Particles, that were diſpers'd through the Air before, had not the power to introduce a malignant conſtitution into the Air, and to act as truly Peſtilential, till they were enabled to do ſo by being aſſociated with the ill-ſcented *Effluvia* of the Soap.

Whether alſo Salutary, and, if I may ſo call them, Alexipharmacal Corpuſcles may not be produc'd in the Air by Coalition, might be very well

well worth our Enquiry: Especially if we had a competent Historical Account of the yearly ceasing of the Plague at *Grand Cayro*. For, as I have elsewhere noted out of the Learned *Prosper Alpinus*, who practis'd Physick there; and as I have also been inform'd by some of my Acquaintance who visited that vast City, that almost in the midst of Summer as soon as the River begins to rise*, the Plague has its malignity suddenly check'd, even as to those that are already infected, and soon after ceases; so if other Circumstances contradict not, one might guess, that this strange *Phænomenon* may be chiefly occasion'd by some Nitrous or other Corpuscles that accompany the overflowing *Nile*, and by associating themselves with what *Hippocrates*

* *The Plague which here miserably rageth upon the first of the Flood doth instantly cease; in so much as when five Hundred dye at* Cayro *the day before, which is nothing rare, (for the sound keep company with the sick, holding Death fatal, and, to avoid them, Irreligion,) not one doth dye the day following*; says Mr. *Sandys* in his Travels, *Lib.* 2.

crates ſomewhere calls νοσηρὰς ἀναῤῥοίας, diſable them to produce their wonted pernicious Effects. To which Hypotheſis ſuits well what is deliver'd by more than one Traveller into *Egypt*, and more particularly by our Ingenious Countreyman Mr. *George Sandys*, who not only takes notice, that about the time of the overflowing of *Nilus*, whoſe abounding with Nitre has been obſerved even by the Antients, there is a certain moiſtening Emanation diffus'd thorow the Air. *To prove*, ſayes he*, ſpeaking of the overflowing of *Nilus*, that it proceedeth from a natural Cauſe, this one, though ſtrange, yet true Experiment will ſuffice. Take of the Earth of *Egypt* adjoining to the River, and preſerve it carefully, that it neither come to be wet nor waſted, weigh it daily, and you ſhall find it neither more nor leſs heavy until the ſeventeenth of *June*, at which day it beginneth to grow more ponderous, and augmenteth

* *Mr.* Sandys *in the Book above-cited.*

menteth with the augmentation of the River, whereby they have an infallible knowledge of the ſtate of the Deluge, proceeding without doubt from the Humidity of the Air, which having a recourſe through all paſſible places, and mixing therewith increaſeth the ſame, as it increaſeth in moiſture.

That theſe Sanative Steams perform their Effects meerly becauſe they are moiſt, I preſume Naturaliſts will ſcarce pretend; but that they may be of ſuch a nature as by their Coalition with the Morbifick Corpuſcles to increaſe their Bulk and alter their Figure, or precipitate them out of the Air, or clog their Agility, or pervert their Motions, and in a word deſtroy all or ſome at leaſt of thoſe Mechanical Affections which made thoſe Corpuſcles Peſtilential: That, I ſay, theſe Antidotal Vapours (if I may ſo call them) may have theſe Effects upon thoſe that formerly were Morbifick, and that ſo there may reſult from the Aſſociation of

two

two ſorts of Particles, whereof one was of a highly noxious nature, a harmleſs mixture, might here be made probable by ſeveral things; but that I hope what I have lately recited about the Coalitions of the *Effluvia* of Spirit of Salt and of Urine (Liquors known to be highly contrary to each other) is not already forgotten by you.

And the Experiment with which I am to conclude this Eſſay will perhaps make you think it poſſible, that the Peſtiferous Steams that have already paſs'd out of the Air, and invaded, but not too much vitiated, the Bodies of Men, may have their malignity much debilitated by the ſupervening of theſe Antidotal Particles. For in that Experiment you will find, that the Steams emitted into the Air from the Liquor there deſcribed, though that were actually cold, were able to reach, and manifeſtly to Operate, (and that probably by way of Præcipitation,) upon Corpuſcles that were fenc'd from them by

by the Interpoſition of other Bodies, not more porous than thoſe of living Men. Whether the fume of Sulphur, which by many is extoll'd to prevent the Infection of the Air, do by its acid or other Particles diſarm, if I may ſo ſpeak, the Peſtilential ones, I have not now time to inquire: No more than whether in *Ireland* and ſome few other Countries, that breed or brook no poyſonous Animals, that hoſtility may proceed, at leaſt in great part, from the peculiar Nature of the Soyl, which both from its ſuperficial and deeper parts, conſtantly ſupplies the Air with Corpuſcles deſtructive to venemous Animals. And ſome other Particulars, that may be pertinently enough conſider'd here, you may find treated on in other Papers. And therefore at preſent I ſhall only intimate in a word, that having purpoſely made a viſible and laſting Stain on a ſolid Body barely by cold *Effluvia*, I did by the inviſible and cold Steams of another Body make in two or three Minutes a viſible

visible change in the colour of that Stain.

And as for the other part of the Conjecture, *(viz.)* That Meteors may sometimes be produc'd by the Occursions of Subterraneal *Effluvia*, some of them of one determinate Nature, and some of another, I think I could, to countenance it, give you divers Instances of the plentiful Impregnation of the Air at some times, and in some places, with Steams of very differing Natures, and such as are not so likely to be attracted by the Heat of the Sun, as to be sent up from the Subterraneal Regions, and sometimes from Minerals themselves. But for Instances of this kind, I shall, for brevities sake, refer you to another Paper*, where I have purposely treated of this Subject, and particularly shewn; That though usually the Effluxions that come from under ground are ill-scented; yet they are not alwayes so; and also that Sul-

* *An Essay of* Subterraneal Exhalations.

phureous Exhalations even from cold, and, for the moſt part, Aqueous Liquors may retain their determinate nature in the Air, and act accordingly upon ſolid Bodies themſelves, to whoſe Conſtitution thoſe *Effluvia* chance to be proportionate.

But one memorable Story not mention'd in that Diſcourſe is too much to our preſent purpoſe to be here omitted, eſpecially having met with it in ſo approved an Author as the experienc'd *Agricola*; who having mention'd out of antient Hiſtorians the Raining of White and Red liquors, which they took (erroneouſly I doubt not) for Milk and Blood, ſubjoyns, * *Ut autem majorem fidem habeamus Annalium monumentis facit res illa decantata, quæ Patrum memoriâ* (in another place he ſpecifies the Year of our Lord) *in* Suevia *accidit; Aer enim ille ſtillavit guttas, quæ lineas veſtes crucibus rubris quaſi ſanguineis imbuebant.* Which I the rather mention, becauſe it does

* *Agric.* de Nat. eorum quæ effluunt è Terra, *Lib.* 12. *pag.* 236.

not

not only prove what I alledge it for; but may keep, what is lately and very credibly reported to have happen'd in divers places of the Kingdom of *Naples* ſoon after the Fiery Eruption of *Veſuvius*, from being judg'd a *Phænomenon* either altogether fabulous, (as doubtleſs many have thought it,) or a Prodigie without all example, as is preſum'd even by thoſe that think it not miraculous. And to this I add, that 'twill be the leſs improbable, that the more agile Corpuſcles of Subterraneal Salts, Sulphurs and Bitumens, may be rais'd into the Air, and keep diſtinct natures there, if ſo fixt a Body as common Earth it ſelf can be brought to ſwim in the Air. And yet of this the worthy Writer newly quoted gives us, beſides what Annals relate, this Teſtimony upon his own knowledge: * *Certè hîc Kempnicii undecimum abhinc annum menſe Septembri effluxerunt imbres, ſic cum terra lutea*

* *Agric.* de Nat. eorum quæ è Terra effluunt, *Lib.* 12. *pag.* 263.

commiſti, ut eâ paſſim plateas ſcilicet ſtratas viderem conſperſas.

And to ſhew you that in ſome caſes the Particles even of Vegetable Bodies may not ſo ſoon periſh in the Air as they vaniſh there, but may retain diſtinct natures at a greater diſtance, than one would think, from the Bodies that copiouſly emit them; I ſhall add, that having deſir'd an ingenious Gentleman, that went on a conſiderable Employment to the *Eaſt-Indies*, to make ſome Obſervations for me in his Voyage; he ſent me among other things this Remarque: That having ſayl'd along the Coaſt of *Ceylon*, (famous for Cinnamon-trees and well-ſcented Gums,) though they Coaſted it almoſt a whole day, the Wind, that then chanc'd to blow from the ſhoar, brought them a manifeſtly odoriferous Air from the Iſland, though they kept off many miles (perhaps twenty or twenty-five) from the ſhoar. Nor ſhould this be thought incredible, becauſe the diffuſion ſeems ſo diſproportionate to that

that of other Bodies diſſolved by Fluids; as, for inſtance, though Salt be an active Body and reſoluble into abundance of minute Particles, yet one part of Salt will ſcarce be taſtable in an hundred parts of Water. For ſenſibly to affect ſo groſs an Organ as that of our Taſt, there is uſually required in ſapid Particles a bigneſs far exceeding that which is neceſſary to the making Bodies fit Objects for the ſenſe of Smelling, and, which is here mainly to be conſidered, there is a great difference between the power a Body has to impregnate ſo thin and fine a Fluid as Air, whoſe parts are ſo rare and lax, and that which it has to impregnate Liquors, ſuch as Water or Wine, whoſe parts are ſo conſtipated as to make it not only viſible and tangible, but ponderous. On which occaſion I remember that having had a Curioſity to try how far a ſapid Body could be diluted without ceaſing to be ſo, I found by Tryal, that one drop of good Chymical, and, as Artiſts call it, Eſſential

Oyl of Cinnamon being duly mix'd by the help of Sugar with Wine, retain'd the determinate taſt of Cinnamon, though it were diffus'd into near a quart of Wine. So that making a moderate eſtimate, I concluded, that upon the common ſuppoſition, according to which a drop is reckon'd for a Grain, one part of Oyl had given the ſpecifick Taſt of the Spice, it was drawn from, to near fourteen thouſand parts of Wine. By comparing which Experiment with what I noted about the proportion of Salt requiſite to make Water taſt of it, you will eaſily perceive; that there may be a very great difference in point of diffuſiveneſs between the little Particles that make Bodies ſapid: Which may ſerve to confirm both ſome part of the *firſt Chapter* of the foregoing Eſſay of the Subtilty of *Effluvia*, and what I was lately ſaying to ſhew it poſſible, that Antimonial Glaſs might impart ſtore of Steams to the Emetick Wine, without appearing upon common Scales to have loſt of its weight;

weight; ſince we ſee, that one Drop of ſo light a Body as Oyl may communicate not inſenſible *Effluvia*, but taſtable Corpuſcles to near a Quart of Liquor. But this is not all for which I mention our Experiment: for I muſt now add, that beſides the almoſt innumerable Sapid parts of a ſpicy Drop communicated to the Wine, it thence diffuſed a vaſt number of odorous Particles into the Air, which both I, and others perceived to be imbued with the diſtinct ſcent of Cinnamon, and which perhaps the Liquor would have been found able to have Aromatized for I know not how long a time, if I had had leiſure to proſecute the Obſervation.

Chap. V.

THE third and laſt way I ſhall mention of ſhewing the Determinate Nature of Effluviums, is to

be taken from the Consideration of their Effects upon other Bodies than the Organs of our Senses; (for of their Operations upon these we have already spoken in the foregoing *Chapter.*) For the Effects, that certain Bodies produce on others by their Effluviums, being constant and determinate, and oftentimes very different from those, which other Agents by their Emissions work upon the same and other subjects, the distinct nature of the Corpuscles emitted may be thence sufficiently gather'd.

We may from the foregoing Tract of the Subtilty of *Effluvia*, borrow some Instances very pertinent to this place. For the temporary benumbedness or stupefaction, for example, produc'd in the Fisherman's Foot by the *Effluvia* * of the Fish (*Amoreatim*) mention'd by the Ingenious *Piso*, manifests, that those stupifying Emanations retain'd a peculiar and venemous nature during their whole passage through

* *See the Essay of the* Subtilty *of* Effluviums, *Chap.* 4.

through the Shoe, Stocking and Skin, interpos'd betwixt the Fiſh and the nervous part of the Foot benumb'd by it. And though there are very few other Bodies in the World, that are minute enough to paſs through the pores of Glaſs, 'tis apparent, by the Experiment there recited of the oblong Iron Hermetically ſeal'd up in a Glaſs-pipe, that the Magnetical *Effluvia* of the Earth may retain their peculiar and wonderful nature in a ſmallneſs that qualifies them to paſs freely through the pores of Glaſs it ſelf.

But that I may neither repeat what you have already met with in the foregoing Tract, nor anticipate what I have to ſay in the next; I will employ in this *Chapter* ſome Inſtances that may be ſpar'd from both.

That divers Bodies of a Venemous nature may exerciſe ſome ſuch Operations upon others by their Effluviums tranſmitted through the Air, as they are wont to do in their groſs ſubſtance, is a Truth, whereof though

I have

I have not met with *many*, yet I have met with *some* Examples among Physicians.

The Learned * *Sennertus* observes as a known thing, that the Apprentices of Apothecaries have been cast into profound Sleeps, when in distilling *Opiat* and *Hypnotick* Liquors they have received in at their Nostrils the Vapours exhaling from those Bodies.

* *Lib. 6. parte 7. cap. 1.*

'Tis recorded by the * Writers about Poysons, that the root and juyce of *Mandragora* casts those, that take it, into a deep *Sopor* not unlike a Lethargy. And though the Apples of the same Plant be thought to be much less malignant; yet *Levinus Lemnius* relates that it happen'd to him more than once; that having laid some Mandrake-Apples in his Study, he was by their Steams made so sleepy, that he could hardly recover himself; but the Apples being taken away he regain'd

* *In Explicatione Herbarum Eiblicarum, cap. 2.*

regain'd alacrity, and threw off all drowſineſs.

Among all Poyſons there is ſcarce any whoſe *Phænomena* are in my opinion more ſtrange than thoſe that proceed from a mad Dog; and yet even this Poyſon, which ſeems to require Corpuſcles of ſo odd and determinate a nature, is recorded by Phyſicians to have been conveyed by Exhalations. *Aretæus* writes (as a Learned modern quotes him,) *Quòd à rabido cane, qui in faciem, dum ſpiritus adducitur, tantummodò inſpiraverit, & nullo modo momorderit, in rabiem homo agatur.* And as there are relations, among Phyſicians, of Animals, that have become *Rabioſi* by having eaten of the parts or excrements of rabid Animals; ſo * *Celius Aurelianus*, who writes, that ſome have been made to run mad, not by being bitten, but wounded only with the Claws of a mad Dog, tells us alſo of a man, that fell into a *Hydrophobia* (which is wont to be a high degree

* *Libro* 3. *Acutor. Morbor.*

degree of the *Rabies*, and by ſome of the antienter Writers was employ'd to ſignifie that Diſeaſe) without being bitten by a mad Dog, but infected *ſolo odore ex rabido cane attracto.* By which Odours in this and other Narratives of Poyſons I underſtand not a bare Scholaſtick *ſpecies*, but a ſwarm of *Effluvia*, which moſt commonly are all or at leaſt ſome of them odorous. And though it may juſtly ſeem ſtrange to many, that the Venom of a mad Dog ſhould be communicated otherwiſe than by biting, which is ſuppos'd to be the only way he can infect by; it may appear leſs improbable, becauſe *Matthæus de Gradibus* names a perſon, who, he ſays, prov'd infected after many days, by only having put his Hand into the Mouth of a mad Dog, who did not bite him. And the formerly mentioned *Matthiolus* relates, that he ſaw two, that were made rabid without any wound by the ſlabber of a mad Dog, with which they had the misfortune to be beſmear'd.

* *Sen-*

**Sennertus* himſelf affirms of a Painter of his acquainance, that, when he had open'd a Box, in which he had long kept included *Realgar*, a noxious Mineral, ſometimes uſed by Painters and not unknown to Chymiſts, and had unfortunately ſnuff'd in the Steams of it, he was ſeis'd with a giddineſs in his Head and fainting fits, his whole Face alſo ſwelling, though by taking of Antidotes he eſcap'd the danger.

* Sennert. *Libr. 6. part. 6. cap. 2.*

Divers other Examples we have met with in the writings of Phyſicians, which I forbear to add to theſe, becauſe, I confeſs, I very much doubt the Truth of them, though the deliverers of ſome of them be men of Note. But the probability of moſt of the things already cited out of credible Authors may be ſtrengthned by what I ſhall now ſubjoyn, as a further proof of the diſtinct Nature of *Effluvia*; of which it will be a very conſiderable Proof, if Medicines, which are of a milder and more

more familiar nature and operation than Poyſons, ſhall yet be able in ſome caſes to retain, in their inviſible Particles ſwimming in the Air, the ſame, (though not ſo great) power of Purging, which is known to belong to them when their groſs Body is taken in at the Mouth. Of this I have elſewhere, on another occaſion, given ſome Examples. To which I ſhall now add, that I know a Doctor of Phyſick, that is uſually Purg'd by the Odours or Exhalations of a certain Electuary, whoſe Cathartick Operation, when it is taken in ſubſtance, is wont to be but languid. And another Doctor of my acquaintance, cauſing good ſtore of the root of black Hellebore to be long pounded in a mortar, moſt of thoſe, that were in the room, and eſpecially the party that pounded it, were thereby purg'd, and ſome of them ſtrongly enough. And the Learned *Sennertus* ſomewhere affirms, that ſome will be purg'd by the very Odour of *Colocynthis*. And 'tis not to be paſs'd by unre-

unregarded, that in the caſes I have alledg'd, Exhalations, that are endow'd with Occult Qualities, (for thoſe of Cathartick Medicines are reckon'd among ſuch) aſcend into the Air without being forc'd from the Bodies they belong'd to by an External heat.

And if I would in this place alledge Examples of the Operations of ſuch *Effluvia*, as do not paſs into the Air, but yet operate only by the contact of the External parts of the Body, I could give Inſtances, not only of the *Purgative*, but the *Emetick* Qualities of ſome Medicines exerted without their being taken in at the Mouth, or injected with Inſtruments.

There are alſo other ſorts of Examples than thoſe hitherto mentioned, that argue a Determinate Nature in the Effluxions of ſome Bodies emitted into the Air. Approv'd Writers tell us, that the Shadow of a Walnut-tree with the Leaves on it is very hurtful to the Head; and ſome Inſtances they give us of great miſchief it has

ſome-

ſometimes done. And though the Shadow, as ſuch, is not likely to be guilty of ſuch bad Effects; yet the *Effluvia* of the neighbouring Plant may be noxious enough to the Head. For I, that was not at all prepoſſeſs'd with an opinion that it was ſo, and therefore without ſcruple reſorted to the Shade of Walnut trees in a hot Countrey, was by experience forc'd to think it might give others the Head-ach, ſince it did to me, who, thanks be to God, both was, and am ſtill very little ſubject to that diſtemper. And this brings into my mind an Obſervation that I have met with among ſome ingenious Travellers into the *Weſt-Indies*, who obſerve in general, and of late a Countrey-man of our own affirms it in particular, of the poyſonous *Manchinello-tree*, that Birds will not only forbear to eat of the Fruit of venemous Plants, but, as to ſome of them, will not ſo much as light on the Trees: Which I therefore mention, becauſe probably Nature inſtructs them to avoid ſuch

ſuch Trees by ſome noxious Smell, or other Emanation, that offends the approaching Birds. And I remember, that ſome of our Navigators give it for a Rule to thoſe that happen to land in unknown Iſlands or Coaſts, that they may venture to eat of thoſe parts of Fruits which they can perceive, the Birds, like kind Taſters, to have been pecking at before.

Nicolaus Florentinus (cited by *Sennertus*) tells us of a certain *Lombard*, that having in a Houſe, that he nam'd, at *Florence*, burn'd a great black Spider at the flame of a Candle, ſo unwarily, that he drew in the Steams of it at his Noſtrils, preſently began to be much diſorder'd and fell into a fainting fit, and for the whole night had his Heart much diſaffected, his Pulſe being ſo weak, that one could ſcarce perceive he had any; though afterwards he was cured by Treacle, Diamoſc, and the powder of Zedoary mixt together.

And I remember, that being ſome years ago in *Ireland*, I gather'd a

certain Plant (peculiar to ſome parts of that Countrey) which the Natives call *Maccu-buy*, becauſe of ſtrange Traditions that go about it; the chief of which I found by tryal not to be true: But yet being ſatisfied, that its Operations were odd and violent enough, I was willing to gratifie the chief Phyſician of the Countrey, who was deſirous I ſhould propoſe to him ſome wayes of correcting it; and whilſt I was ſpeaking of one that required the pounding of it, he told me on that occaſion, that intending to make an extract of it with Vinegar, he caus'd his man to beat it well in a Mortar, which the man ſoon repented he had begun to do: And the Doctor himſelf, though at a pretty diſtance off, was ſo wrought upon by the Corpuſcles that iſſued out into the Air, that his Head, and particularly his Face, ſwell'd to an enormous and disfiguring bulk, and continued tumid for no inconſiderable time after.

I have not leiſure to ſubjoyn many more

more Instances to shew the Determinate Nature of Effluviums, small enough to wander through the Air; nor perhaps will it be necessary, if you please but to consider these two things. The *first*, that many odoriferous Bodies, as Amber, Musk, Civet, *&c.* as they will, by the adhesion of their whole substance, perfume Skins, Linnen, *&c.* so they will in time perfume some Bodies disposed to admit their action, though kept at a distance from them. And the *other* is, that in Pestilential Feavers and divers other Contagious sicknesses, as the Plague, Small-pox, or Measels, the same determinate Disease is communicable to sound persons, not only by the immediate contact of the infected party, but without it, by the Contagious Steams that exhale from his Body into the Air. And having said this and desir'd you to reflect upon it, I shall conclude this *Chapter* with an Experiment, that possibly will not a little confirm a great part of it.

Considering then with my self, how I might best devise a way of shewing to the very Eye, That *Effluvia* elevated without the help of Heat, and wandering in the Air, may *both* retain their own Nature, *and* upon determinate Bodies produce Effects, that a Vulgar Philosopher would ascribe to Occult Qualities: I remember'd, that I had found by tryals (made to other purposes) that Volatile and Sulphureous Salts would so work upon some Acid ones sublim'd with Mercury, as to produce an odd diversity of Colours, but chiefly an Inky one; on which account I judg'd it likely that my aim would by answer'd by the following Experiment.

I took an Ounce, or better, of such a Volatile Tincture of Sulphur, as I have elsewhere* taught you to make of Quick-lime, Sulphur and *Sal Armoniack*, and stop'd it up in a Vial capable

* *The Liquor here mention'd is, for the main, the same with that describ'd by the Author in his Book of* Colours, *Experiment the*

capable of containing at leaſt twice as much; then taking a Paper whereon ſomething had been written with inviſible Ink, I laid it down ſix Inches off of the Vial, which, being unſtop'd, began, upon the acceſs of the Fire, to emit white Fumes into it, and by theſe, what was written upon the Paper, notwithſtanding its diſtance from the Liquor, quickly became very legible, though not quite ſo ſuddenly, as if a Paper, written with the ſame clear Liquor, were held at the like diſtance directly over the orifice of the Vial. And having caus'd ſeveral pieces of clean Paper to be written on, with a new Pen dip'd in the clear Solution of Sublimate made in Water, 'twas pleaſant to ſee, how divers of the Letters of ſeveral of theſe Papers, being plac'd within ſome convenient diſtance of the Vial, would be made plainly legible, and ſome of them more, ſome leſs blackiſh, according to their diſtances from the ſmoaking Liquor, and other Circumſtances. But 'twas

more ſurprizing to ſee, that when I held or laid ſome of theſe Papers, though with the written ſide upwards, juſt upon or over the orifice of the Vial, though the contained Liquor did not by ſome Inches reach ſo high, yet the latent Letters would become not only legible but conſpicuous in about a quarter of a Minute of an Hour (meaſur'd by a good Watch fit for the purpoſe, as more than one tryal aſſur'd me.) And as it may be obſerv'd, that in ſome Circumſtances the ſmoaking Liquor and the Solution of Sublimate will make an odd Precipitate almoſt of a ſilveriſh colour, ſo in one or two of our Tryals we found a like colour produc'd, by the Steams of that Liquor, in ſome of the colourleſs Ink. Nor is it ſo neceſſary to employ a viſibly ſmoaking Liquor for the denigrating of inviſible Ink at a diſtance. For I have, to that purpoſe, with good ſucceſs, though not equal to that I have recited, employ'd a couple of Liquors, wherein there was neither Sulphur,

nor

nor *Sal Armoniack*, nor Sublimate. What other Tryals I made with our Volatile Tincture of Sulphur, 'tis not neceſſary here to relate; only one Experiment, which you will poſſibly think odd enough, I ſhall not omit; becauſe it will not only confirm the precedent Tryals, but alſo much of the foregoing Eſſay, by ſhewing the great Subtilty and penetrating power of Effluviums that ſeem rather to iſſue out very faintly, than to be darted out with any briskneſs.

Cauſing then ſomething to be written with diſſolv'd Sublimate upon a piece of Paper, we folded the Paper with the written ſide inwards, and then inclos'd this in the midſt of ſix ſheets of Paper, laid one upon another, not plac'd one within another, and folded up in the form of an ordinary Letter or packet to be ſeal'd, that, the edges of the encloſing Paper being inſerted one within the other, the Fumes might not get into this written Paper but by penetrating through the Leaves themſelves: This

done, that side of the Packet, on which there was no commissure, and on which, were it to be sent away, the Superscription should be written, was laid upon the orifice of the Vial, which (as was before intimated) was some Inches higher than the surface of the Liquor, and left there about ten Minutes; after which taking off the folded Papers, and opening them, we found, that the Steams had pervaded all the Leaves, in which the written Paper had been enclos'd. For, though the Leaves did not appear stain'd or alter'd, yet the formerly latent Characters appear'd conspicuous. I have not time to discourse, whether and how far this Experiment may assist us to explain some odd Effects of Thunder, or of that strange *Phænomenon*, (glanc'd at in the foregoing Chapter,) which is said to have happen'd lately in the Kingdom of *Naples* after the great Eruption of *Vesuvius*, which is said to have been follow'd by the appearing of the Crosses formerly mention'd, some of which

which have been found on the innermoſt parts of Linnen, that had been carefully folded up. But of theſe and the like things, I ſay, I have now no time to diſcourſe, whether any thing derivable from our Experiment may be pertinently apply'd to their Explication. For which reaſon I ſhall add no more than that afterwards for further tryal we took a printed Book, that chanc'd to be at hand, and which we judg'd the fitteſt for our purpoſe, becauſe the leaves being broad they might the better preſerve a ſmall Paper to be plac'd in the mid'ſt of them from being acceſſible to the Exhalations ſidewiſe, and having put the deſign'd Paper into this Book, and held it to the orifice of the Vial, though there were no leſs than twelve leaves between them; yet thoſe Letters, that happen'd to be the moſt rightly plac'd, were made inky in the ſhort ſpace of three Minutes at the utmoſt; though this Liquor had been ſo long kept and ſo often unſtop'd to try Concluſions with it, that

that it had probably loſt a good part of the moſt ſpirituous and piercing Particles.

NEW

NEW EXPERIMENTS, To make the PARTS OF *FIRE* and *FLAME* Stable & Ponderable.

BY

The Honorable Robert Boyle.

LONDON:

Printed by WILLIAM GODBID, for *Moſes Pitt*, at the Sign of the White Hart in *Little Britain*. 1673.

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A PREFACE; SHEWING The Motive, Design, and Parts of the ensuing Tract.

THE *Inducements which put me upon the Attempt, expres'd in the Title of this* Essay, *were chiefly these:*

First, *I consider'd, that the Inter-Stellar part of the Universe, consisting of Air and* Æther, *or Fluids analogous to one of them, is diaphanous; and that the* Æther *is, as it were, a vast Ocean, wherein the Luminous globes, that here and there like Fishes* swim *by their own motion, or like Bodies in Whirlpools are* carried about *by the Ambient, are but very thinly dispers'd, and consequently that the proportion, that the Fixt Stars*

and

and Planetary Bodies bear to the diaphanous part of the World, is exceeding small and scarce considerable; though we should admit the Sun and Fixt Stars to be Opacous Bodies upon the account of their terminating our sight: Which diffident Expression I employ, because I have elsewhere shewn by two or three Experiments, purposely devised, that a Body may appear opacous to our Eyes, and yet allow free passage to the beams of Light.

I further consider'd, that there being so vast a disproportion between the diaphanous part of the World and the Globes, about which 'tis every way diffused, and with which it is sometimes in great portions mingled, as in the Water, which together with the Earth makes up the Globe we inhabit; and the nature of Diaphanous Bodies being such, that, when the Sun or any other Luminous Body illustrates them, that which we call Light does so penetrate and mix it self per minima with them, that there is no sensible part of the transparent Body unenlightned; I thought it worth the enquiry, whether a thing, so vastly diffused

as

as Light is were some thing Corporeal or not? And whether, in case it be, it may be subjected to some other of our Senses besides our Sight, whereby we may examine, whether it hath any affinity with other Corporeal beings, that we are acquainted with here below?

I did not all this while forget, that the Peripateticks make Light a meer Quality, and that Cartesius ingeniously endeavours to explicate it by a modification of Motion in an Ætherial matter: But I remember'd too, that the Atomists of old, and of late the Learned Gassendus, and many other Philosophers assert Light to be Corporeal; and that some Years since, though I declined to pass my Judgement about the Question, yet I had employ'd Arguments, that appear'd plausible enough to shew, That 'twas not absurd to suppose, that the Sun, which is the Fixt Star most known to us, might be a Fiery Body. And therefore doubting, whether the Corporeity of Light would be in haste Determined by meer Ratiocinations, I thought it very well worth the endeavouring to try whether I could do any

thing

thing towards clearing the dispute of it by Experiments; especially being perswaded, that, though such an attempt should be ineffectual, it would but leave the controversie in its former state, without prejudicing either of the contending Hypotheses; and yet, if it should prove successful, the consequences of it would be very great and useful towards the explicating of divers Phænomena in divers parts of Natural Philosophy, as in Chymistry, Botanicks, and (if there be any such) the allowable part of Astrologie. (Nor perhaps would it be impossible by the help of slight Theorical alterations, to reconcile the Experiments, I design'd, to either of the above-mention'd Hypotheses, and so, as to the Explication of Light, to one another.)

To compass then, what I aim'd at, I thought, 'twas fit in the first place to try, what I could do by the Union of the Sun-beams, they being on all hands confess'd to be Portions (as I may so speak) of true and Celestial Light: And then, I thought fit to try, what could be obtain'd from Flame; not only because that

that is acknowledg'd to be a Luminary, but because I hoped, the difficulties, I foresaw in the other Tryals, might be in some measure avoided in those made with Flame; and if both sorts of them should succeed, the later and former would serve to confirm each other. According to the Method I proposed of handling these two Subjects, I should begin with some account of what I attempted to perform in the Sun-beams. But the truth is, that when I chanc'd to fall upon the Enquiry that occasion'd this Paper, besides that the time of the Year it self was not over-favourable, the Weather proved so extraordinary dark and unseasonable that it was wonder'd at; so that, though I was furnish'd with good Burning-glasses, and did several times begin to make tryals upon divers Bodies, as Lead, Quicksilver, Antimony, &c. yet the frequent interposition of Clouds and Mists did so disfavour my Attempts, that, however they were not all alike defeated, yet I could not prosecute the greatest part of them to my own satisfaction. And therefore being unwilling to build on them as yet,

I ſhall reſerve an account of them for another opportunity; and now proceed to the mention of that ſort of Experiments which depending leſs on Caſualties, 'twas more in my power to bring to an Iſſue.

I know I might have ſaved both you and my ſelf ſome time and pains by omitting ſeveral of theſe Tryals, and by a more compendious way of delivering the reſt. But I rather choſe the courſe I have taken; partly *becauſe the Novelty and Improbabilities of the Truth I deliver ſeems to require, that it be made out by a good number of Tryals*; partly *becauſe I thought it might not be altogether uſeleſs to you and your Friends, to ſee upon what Inducements the ſeveral ſteps were made in this Inquiry*; partly *becauſe I was willing to contribute ſomething towards the Hiſtory that now perhaps will be thought fit to be made of the Increment or Decrement that particular Bodies may receive by being expoſed to the Fire*; *and* partly (*in fine*) *becauſe the Incongruity of the Doctrine here aſſerted to the Opinions of the Schools, and the general Prepoſſeſſions*

of

of Mankind, made me think it fit by a considerable Variety, as well as number, of Experiments to obviate, as far as may be, the differing Objections and Evasions wherewith a Truth so paradoxical may expect to be encountred.

New EXPERIMENTS,

To make

FIRE and FLAME PONDERABLE.

THough there be among the following Tryals a Diverſity that invites me, as to rank them into four or five differing ſorts, ſo to aſſign them as many diſtinct Sections; yet for the conveniency of making the References, there will be occaſion to make betwixt them, I ſhall wave the Diſtinction, and ſet them down in one continued *Series*.

And becauſe I am willing to comply with my haſt, as well as to deal frankly and without Ceremony with you, I ſhall venture to ſubjoyn the naked Tranſcripts of my Experiments, as I had in an artleſs manner

ſet them down with many others for my own remembrance among my *Adverſaria*, without ſo much as retrenching ſome Circumſtances that relate leſs to my preſent Argument, than to ſome other purpoſes.

I ſhall then begin with the mention of a couple of Experiments, which, though they might conveniently enough be referr'd to another Paper; yet I ſhall here ſet them down, becauſe it ſeems very proper to endeavour to ſhew in the firſt place, that Flame it-ſelf may be as 'twere incorporated with cloſe and ſolid Bodies ſo as to increaſe their bulk and weight.

Tryals of the Firſt ſort.

EXPERIMENT I.

A Piece of Copper-plate not near ſo thick as a Half-crown, and weighing two Drachmes and twenty-five Grains, was ſo plac'd with its broad part Horizontal, in a Crucible, whoſe bottom had a little hole in it, for Fumes to get out at, that it could not be removed from its Poſition, nor be eaſily made to drop down or loſe its Level to the Horizon, though the Crucible were turned upſide down: Then about an Ounce and half of common Sulphur being put into a taller and broader Crucible, that, wherein the Copper ſtuck, was inverted into the orifice of it, that the Sulphur being kindled, the flame, but not the melted Brimſtone in ſubſtance, might reach the Plate, and have ſome vent beyond it at the above-mentioned hole.

This Brimstone burn'd about two Hours, in which time it seem'd all to have been resolved into Flame, no flowers of Sulphur appearing to have sublimed into the inside of the upper Crucible; and though the Copper-plate were at a considerable distance from the ignited Sulphur, yet the Flame seem'd to have really penetrated it, and to have made it visibly swell or grow thicker; which appear'd to be done by a real accession of substance: since, after we had wip'd off some little adhering *sordes*, and with them divers particles of Copper that stuck close to them, the Plate was found to weigh near two and thirty Grains more than at first, and consequently to have increased its former weight by above a fifth part.]

EXPER. II.

[Having, by refining one Ounce of sterling Silver with Salt-peter, according to our way reduc'd it to seven Drachms or somewhat less;

we

we took a piece of the thus purified Silver, that weighed one Drachm wanting two Grains, and having order'd it as the Copper-plate had been in the former Experiment, after the flame of above one Ounce and a quarter of Sulphur, (that Quantity chancing to be ſuitable to the Capacity of the Crucible) had for about an Hour and a half beat upon it, the Silver-plate ſeem'd to the Eye ſomewhat ſwell'd, and the lower ſurface of it, that was next the flame, was brought to a great ſmoothneſs, the weight being increas'd to one Drachm five Grains and three quarters; which increaſe of weight falling ſo ſhort of that which was gain'd by the Copper, I leave it to you to conſider, *whether* the difference may be attributed to the cloſeneſs and compactneſs of the Silver, argued by its being heavier in *ſpecie* than Copper; *or* to the greater congruity of the pores of Copper to be wrought on by the fiery *Menſtruum*; *or* to ſome other cauſe.]

If

If you ſhould here ask me, by what Rational inducements I could be led to entertain ſo extravagant an expectation, as that ſuch a light and ſubtile Body as Flame ſhould be able to give an augmentation of weight to ſuch ponderous Bodies as Minerals and Metals; I ſhall now, to avoid making anticipations here, or needleſs repetitions hereafter, return you only this Anſwer: That the expectation you wonder at may juſtly be entertained upon the ſame or ſuch like inducements, as you may eaſily diſcover in another Paper, entitled *Corollarium Paradoxum*. For, ſuppoſing upon the grounds there laid, that Flame may act upon ſome Bodies as a *Menſtruum*, it ſeems no way incredible, that, as almoſt all other *Menſtruums*, ſo Flame ſhould have ſome of its own Particles united with thoſe of the Bodies expos'd to its action: And the generality of thoſe Particles being, (as 'tis ſhewn in the *Paradox* about the Fewel of Flames,) either Saline, or of ſome

ſuch

ſuch piercing and Terreſtrial nature, 'tis no wonder, that being wedg'd into the Pores, or being brought to adhere very faſt to the little Parts of the Bodies expos'd to their action, the acceſſion of ſo many little Bodies, that want not gravity, ſhould, becauſe of their multitude, be conſiderable upon a Ballance, whereon one or two, or but few of theſe Corpuſcles would have no viſible Effect.

I could here, if it were expedient, mention ſome odd ſcruples about the preceding Experiments, and ſome alſo of the ſubſequent; but, leſt you ſhould, with ſome other of my Friends, upbraid me with being too jealous and Sceptical, I will not trouble you with them; but proceed to the next ſort of Tryals, wherein, though the matter were not always manifeſtly beaten on by a *ſhining* Flame; yet it was wrought on by that, which would be called Flame by thoſe who take not that *word* ſtrictly, but in a latitude, and which this Igneous ſubſtance may more properly be ſtiled, than

than it can be call'd common Fire; this being visibly harbour'd in burning Coals or other gross materials, from which our Metals were fenc'd. And I have elsewhere shewn by experiment, that *Visibility* is not in all cases necessary to Actual Flame, particularly when the Eye receives a predominant impression from another Light.

Tryals of the Second sort.

EXPER. III.

INto a Crucible, whose sides had been purposely taken down to make it very shallow, was put one Ounce of Copper-plates; and this being put into our Cupelling-furnace, and kept there two Hours, and then being taken out we weighed the Copper (which had not been melted) having first blown off all the ashes, and we found it to weigh one Ounce and thirty Grains.

EXPER.

EXPER. IV.

[Suppoſing that Copper, being reduc'd to filings, and thereby gaining more of Superficies in proportion to its bulk, would be more expos'd to the Action of the Fire, than when 'tis in places as it was formerly; we took one Ounce of that Metal in filings, and putting them upon a very ſhallow Crucible, and under a Muffler, we kept them there about three Hours, (whilſt other things that required ſo long a time were Cupelling;) and afterwards taking them off, we found them of a very dark colour, not melted but caked together in one Lump, and increas'd in weight (the aſhes and duſt being blown off) no leſs than about forty-nine Grains. Part of which increment, above that obtained by the Copper-plates in the former Experiment, may not improbably be due to the longer time that in this Experiment the fil'd Copper was kept in the Fire.]

EXPER.

EXPER. V.

[Being willing to see, whether *calcin'd Harts-horn*, that I did not find easie to be wrought on by corrosive *Menstruums*, would retain any thing of the Flame or Fire to which it should be expos'd; we weigh'd out one Ounce of small Lumps of Harts-horn, that had been burnt till they appear'd white, and having put them into a Crucible, and kept them in a Cupelling-furnace for two Hours, whilst some Metals were driving off there by the violence of the Fire; we found, that when they were taken out, they had lost six or seven Grains of their former weight; perhaps *either* because, notwithstanding the external whiteness of the Lumps, the internal Parts of some of them might not be so exquisitely calcin'd, but retain some Oleaginous or other Volatile Substance; *or*, because, having omitted to ignite them well before they were weigh'd, they may have since

ſince their firſt Calcination imbib'd ſome moiſt Particles of the Air. Which conjecture ſeem'd the likelier, becauſe, having kept them a while in the Scales they were weigh'd in, they did within two or three Hours make it ſomewhat preponderate. On which occaſion I ſhall add, that, at the ſame time, with the Harts-horn we put in one Ounce of well-heated Brick, and kept that likewiſe in the Furnace for above two Hours; at the end of which weighing it whilſt it continued hot, we did not find it to have either ſenſibly got or loſt; but, ſome time after, it ſeem'd upon the Ballance to have imbib'd ſome, though but very little, moiſture from the Air.]

EXPER. VI.

[Upon a good Cupel we put one Ounce of *Engliſh* Tin of the better ſort, and having plac'd it in the Furnace under a Muffler, though it preſently melted, yet it did not forſake its

its place, but remain'd upon the concave ſurface of the Cupel, till at the end of about two Hours it appear'd to have been well calcin'd; and then being taken out and weighed by it ſelf, the Ounce of Metal was found to have gained no leſs than a Drachm.]

EXPER. VII.

[An Ounce of Lead was put upon the Cupel, made of calcin'd Hartshorn, and placed under the Muffler after that the Cupel was firſt made hot and then weighed. This Lead did not enter into the Cupel, but was turn'd into a pretty kind of Litharge on the top of it, and broke the Cupel, whereby ſome part of the Cupel was loſt in the Furnace, and yet the reſt, together with the Litharge, weigh'd ſeven Grains more than the Ounce of Lead and the heated Cupel did when they were put in.]

But becauſe, though this tryal ſhew'd that ſome weight was gain'd either by the Metal or Cupel, or both; yet

yet it did not by this appear, what either of them acquir'd; it seem'd fit to subjoyn a further tryal.

EXPER. VIII.

[We took a Cupel about two Ounces in weight, made of about ten parts of Bone-ashes, and one of Charcoal-ashes, made up together with Ale. This was by it self put in a Cupelling-furnace, under a Muffler; and the Laborant, well vers'd in weighing, was order'd to take it out when 'twas throughly and highly heated, and to weigh it whilst 'twas in that condition (I being then present:) This being done, 'twas forthwith plac'd again under the Muffler, where some Metalline Bodies were Cupelling, and kept there for about two Hours; at the end of which time 'twas taken out red-hot; and presently put into the same Ballance, as before, which was already fastned to a Gibbet; where having caus'd the adhering ashes to be blown off,

I found, that whereas, when 'twas first taken from under the Muffler, we had but two Ounces and two Grains, now the same weight being put into the opposite Scale, it had gain'd very near one and twenty Grains. And here note, that 'twas not without some cause, that I was careful to have the Cupel weighed red-hot. For I had a suspition, that, notwithstanding the dryness of the Bone, it might receive some little alteration of weight by imbibing some little Particles wandering in the Air, which suspition the event justified. For leaving the Cupel counterpois'd to cool in the Ballance, in a short time it began sensibly to preponderate, and suffering it to continue there nine or ten hours, till we had occasion to use the Ballance, I found it at the end of that time to be about three Grains heavier than before.

This was not the only tryal we made about the augmenting the weight of Cupels; but this being the fairest, and exempt from those mis-

misfhances, from which the other were not altogether free; I shall content my self to have set down this: In the mention of which I thought fit to take notice of the increase of the weight of the Cupel after it had layn in the Scales, and also that we weighed it at first whilst it was throughly hot, because those Circumstances, as not being suspected, may easily be left unthought on, even by skilful Experimenters; and yet the weighing of the Cupel, when it had been well neal'd, and the not weighing it soon enough after 'tis taken from the Fire, may keep those, that shall reiterate this Experiment, from making it cautiously and accurately enough. For if the former Circumstance be omitted, that which the Cupel may seem to have lost of its substance, was nothing but the adventitious moisture of the Air; and if the later Circumstance be neglected, the weight, it may seem to have gain'd from the Fire, was *indeed* due to the waterish Particles of the Air. I could

wish also, that tryal were made, whether the success would be the same in Cupels made in differing sorts of Bone-ashes, and other materials, wont to be employed for that purpose. For That I had not opportunity to do.

EXPER. IX.

Iron being a Metal, that experience had inform'd me will more easily be wrought on by Fluids that have Particles of a Saline nature in them, than is commonly believed; 'twas not unreasonable to expect, that Flame would have a greater Operation on it, (especially if it were before-hand reduc'd to small Parts) than on any of the Bodies hitherto describ'd. Which supposition will be confirm'd by the short ensuing Note.

[Four Drachms of filings of Steel being kept two Hours on a Cupel under a Muffler, acquir'd one Drachm six Grains and a quarter increase of weight.]

EXPER.

EXPER. X.

[A piece of Silver, refin'd in our own Laboratory, being put upon a Cupel under a Muffler, and kept there for an hour and half, whilſt other things were refining, was taken out and weigh'd again, and, whereas before it weighed three Drachms, thirty-two Grains and a quarter, it now weighed in the ſame Scales three Drachms, thirty-four Grains and a half, or but little leſs.]

Finding this Memorial among divers others about the Weight of Bodies, expos'd to the Fire, I thought it not amiſs to annex it in this place; though finding it to be but ſingle, I would not have it to be rely'd on till further tryal have been made to diſcover, whether it was more than a caſual and anomalous Experiment; and if the Silver had not been refin'd, I ſhould have ſuſpected, that the Copper, that was blended with it, as 'tis uſually blended with common

Silver, might have occasioned the increase of weight.

(*Postcript.*)

Since the foregoing Experiment was first set down, meeting with an opportunity to reiterate the tryal once more, we did it with half an Ounce of filings of Silver, well refin'd with Lead in our own Laboratory, and kept it about three hours upon the Cupel; after the end of which time taking it out, we found it to be of a less pleasant colour than it was of before, and melted (though not so perfectly) into a Lump, which weigh'd four Drachms and six Grains; and yet, the success being so odd, and, if it prove constant, of such moment, I could wish the tryal were further repeated in differing quantities of the Metal.

EXPER. XI.

[We took a Drachm of filings of *Zink* or *Spelter*, and having put it upon

upon a Cupel under a Muffle, we kept it there in a Cupelling-fire about three Hours, (having occasion to continue the Cupellation so long for other tryals;) then taking it off the Cupel, we found it to be caked into a brittle and dark-colour'd Lump, which look'd as if the filings had been calcin'd. This being weigh'd in the same Scales gain'd full six Grains, and so a tenth part of its first weight.]

EXPER. XII.

Among our various tryals upon common Metals, we thought fit to make one or two upon a Metal brought us from the *East-Indies*, and there call'd *Tutenâg*, which name being unknown to our *European* Chymists, I have elsewhere endeavoured to give some account of the Metal it self; whence I shall borrow the ensuing Note, as directly belonging to our present purpose.

[Two Drachms of filings of *Tute-*

nâg being put upon a Cupel, and kept under the Muffler for about two hours, the filings were not melted into a Lump of Metal, but look'd as if Ceruſs and *Minium* being pouder'd had been mingled together, ſome of the parts appearing diſtinctly white, and others red: The *Calx* being put into the Ballance appear'd to have gained twenty-eight Grains and a quarter. Another time the Experiment being reiterated with the like Circumſtances, we found, that two Drachms of the filed *Tutenâg* gained the like increaſe of weight, abating leſs than one Grain.]

So that this *Indian* Metal ſeems to have gain'd more in the fire, in proportion to its weight, than any we have hitherto made tryal of.

EXPER. XIII.

[Being deſirous to confirm by a clear Experiment, what I elſewhere deliver contrary to the vulgar Opinion of thoſe that believe, that in all Cupellations almoſt all the Lead

that

that is employ'd about them, does, together with the baser Metals that are to be purg'd off from the Silver or Gold, fly away in Smoak, as indeed in some sort of Cupellations a good proportion may be blown off that way: We took two Ounces of good Lead and one Drachm of filings of Copper, and having caus'd a Cupel to be ignited, and nimbly taken out of the Furnace, and weighed, whilst 'twas very hot, 'twas presently put back, together with the two Metals laid on it, into the Cupelling-furnace, where having been kept for about two hours, it was taken out again, and 'twas found, according to what (as I elsewhere * note) uses to happen in such Circumstances, to have nothing on the surface of it worth weighing distinctly in the Scales, in which the Cupel with what was sunk into it amounted to four Ounces three Drachms and eleven Grains, which wanted but nine Grains of the whole weight of the

* *Essay the sixth of the* Useful. *of* Nat. Philos.

the Cupel and the two Metals, when they were all three together committed to the Fire.] So that, though we make a liberal allowance for the increment of weight that may with any probability be supposed to have been attained by the Cupel and what was put upon it, yet it will easily be granted, that very much the greater part of the Metals was not driven off in Fumes, but enter'd into the Substance of the Cupel.

Tryals of the Third sort.

AFter having shewn that either Flame or the Analogous Effluxions of the Fire will be, what Chymists would call, Corporified with Metals and Minerals exposed *naked* to its action; I thought it would be a desirable thing to discover, whether this Flame or igneous Fluid were subtile enough to exercise any such Operation upon the Light Bodies shelter'd from its immediate contact

contact by being included in close Vessels; but it being very difficult to expose Bodies in Glasses to such vehement Fires without breaking or melting the Glass, and thereby losing the Experiment; I thought fit, first to employ Crucibles carefully luted together, that nothing might visibly get in or out, and of that attempt I find among my Notes the following Account.

EXPER. XIV.

[We took an Ounce of Steel freshly filed from a Lump of that Metal, that the filings might not be rusty, and having included them betwixt two Crucibles, as formerly, kept them for two hours in a strong Fire, and suffer'd them to continue there till the Fire went out; the Crucibles being unluted, the filings appear'd hard caked together, and had acquir'd a dark colour somewhat between black and blew, and were increas'd five Grains in weight.]

The

The foregoing Experiment being the first I mention of this kind, 'twill not be amiss to confirm it by annexing the following Memorial.

[An Ounce of filings of Steel being put between the Crucibles luted together, after they had been kept about an hour and half in the fire, were taken out, and being weigh'd, were found to have gained six Grains.]

EXPER. XV.

[Two Ounces of Copper-plate were put into a new Crucible, over which a lesser was whelmed, and the commissures were closed with lute, that nothing might fall in. After the same manner two Ounces of Tin were included betwixt Crucibles, and also two Ounces of Lead; these being put into the Cupelling-furnace were kept in a strong Fire about an hour and a half, while something else was trying there. And then being taken out, the event was, that the Copper-plates, though they stuck

ſtuck together, were not quite melted, and ſeem'd ſome of them to have acquir'd ſcales like Copper put into a naked Fire, and the two Ounces had gain'd eight Grains in weight. The Lead held broke through the bottom of the Crucible, and thereby hinder'd the deſign'd Obſervation. The Tin acquir'd ſix Grains in weight, and was in part brought to a pure white *Calx*, but much more of it was melted into a Lump of a fine yellow colour, almoſt like Gold, but deeper.] The proſecution of this tryal as to the Copper-plates you will meet with in *Experim.* XXI. to which I therefore referr you.

N. B. Becauſe Lead in Cupellation enters the Cupel, we were willing to try, if we could ſo far hinder it from doing ſo, as to make ſome eſtimate what change of Weight the Operation of the Fire would make in it: And therefore being able already to make a near gueſs, how much a quantity of Tin may gain by being calcined on a Cupel, and

remem-

remembring also from some of my former tryals the indisposition which Tin gives Lead to Cupellation, we mixed a Drachm of Tin with two Ounces of Lead, and exposing the mixture (in a Cupel) to the Fire under a Muffler, we first brought it to fusion, and then it seem'd at the top dry and swell'd and discolour'd, notwithstanding which, having continued the Operation a good while, because of other things that were to be done with the same Fire, we were not lucky enough to bring the Experiment to an issue worth the relating here, in reference to the scope above-propos'd, though in relation to another the success was welcome enough.]

EXPER. XVI.

[Supposing that if Copper were beaten into thinner plates than those we lately us'd, and kept longer in the fire, this would have a more considerable Operation upon them, we took

took one Ounce of very thinly hammer'd pieces of Copper, and putting them betwixt two Crucibles (one whelm'd over another) as in *Experim.* XV. with some lute at the corners of the juncture, to keep the fire from coming immediately at the Metal, we kept them in the Cupelling-furnace about three hours, and then disjoyning the Vessels; we found the Metal covered with a dark and brittle substance, like that describ'd in the above recited Experiment. Which substance, when scal'd off, disclos'd a finely colour'd Metal, which; together with these burnt scales, amounted to one and twenty Grains above the weight that was first put in.]

If, when these things were doing, I had been furnished with a very good Lute, which is no such easie thing to procure, as Chymists, that have not frequently employed vulgar Lutes, are wont to think; I would have made a tryal of the ensuing Experiment for a good while in the naked Fire, notwithstanding that

divers

divers Metalline Minerals will scarce be brought to fusion in Glasses, especially without such a Fire, whose violence makes them break the Vessels. For I thought, that by making a fit choice of the Metals to be employed, I could prevent that inconvenience: But wanting the Accommodations I desir'd, and yet presuming, that in a Sand-furnace I might by degrees administer heat enough to melt so fusible a Metal as fine Tin, and keep it in fusion; I resolved to make some tryals, first upon that, and then upon another Metal. For though I was not sure of being then able to prosecute the Experiment far enough; yet I hoped, I might at least see some Effects of my first tryal, which would enable me to guess, what I was to expect from a complete one.

EXPER. XVII.

[We took then a piece of fine Block-Tin, and in a pair of good Scales weighed out carefully half a Pound

Pound of it; this we put into a choice Glaſs-retort, and kept it for two days or thereabouts in a Sand-furnace, which gave heat enough to keep the Metal in fuſion without cracking the Glaſs. Then taking out the mixture, we carefully weigh'd it in the ſame Scales, and found the ſuperficies a little alter'd (as if it were diſpos'd to calcination) and the weight to be increaſed about two Grains or ſomewhat better.]

EXPER. XVIII.

[The other Experiment, I tryed in Glaſſes, was with Mercury, hoping, that, if I could make a Precipitate *per ſe* in a Hermetically ſeal'd Glaſs, I ſhould by comparing the weight of the Precipitate, and the Quick-ſilver that afforded it, have a clear Experiment to my purpoſe; and I ſhould have no bad one, if I could but make it ſucceed with a Glaſs, though not ſeal'd, yet well ſtop'd; inſtead of thoſe Infernal-glaſſes (as

they call them) which are commonly us'd and wont to be left open (though ſome ſlightly ſtop them with a little Paper or Cotton:) But though, partly that I might a little diverſifie the Experiment, and make it the more likely to ſucceed in one or other of the Glaſſes, I divided the Mercury and diſtributed it amongſt ſeveral of them, and but a little to each, the ſucceſs did not anſwer expectation, the Hermetically ſeal'd Glaſſes being unluckily broken; and the Precipitation in the others proceeding ſo ſlowly, that I was by a remove oblig'd to leave the tryal imperfect; only I was encouraged, (in caſe of a future opportunity) to renew it another time, by finding that moſt of the Glaſſes, though tall, and ſtop'd with fit Corks, afforded ſome very fair Precipitate, but not enough to anſwer my Deſign.]

Tryals of the Fourth ſort.

MOſt of the Experiments hitherto recited, having been made as it were upon the by with others, whoſe exigencies 'twas fit theſe ſhould comply with; very few of the expos'd Bodies were kept in the Cupelling-fire above two hours or thereabouts. Upon which account I thought fit to try, how much ſome Bodies, that had been already expos'd to the Fire, would gain in weight by being *again* expos'd to it; eſpecially conſidering, that moſt calcinable Bodies, (for I affirm it not of *all*) which yield rather *calces* than aſhes by being without additament reduc'd in the Fire to fine powder, ſeem'd to be by that Operation open'd, or (as a Chymiſt would ſpeak) unlock'd, and therefore probably capable of being further wrought upon and increas'd in weight by ſuch a *Menſtruum* as I ſuppos'd Flame and igneous Exhalations

halations to be. And about this Conjecture I ſhall ſubjoyn the enſuing Tryals.

EXPER. XIX.

[One Ounce of *Calx* of Tin, that had been made *per ſe* for an Experiment in our own Laboratory, being put in a new Cupel and kept under the Muffler for about two hours, was taken out hot and put into the Scales, where the powder appear'd to have gain'd in weight one Drachm and thirty-five Grains by the operation of the Fire, which made it alſo look much whiter than it did before, as appeared by comparing it with ſome of the *Calx* that had not been expoſed to the ſecond Fire: No part of the Puttie was, as we could perceive, melted by the vehemence of the Fire, much leſs reduc'd into Metal.]

EXPER.

EXPER. XX.

[Out of a parcel of filings of Steel, that had been before expos'd to the fire, and had its weight thereby increas'd ſome Grains, not Scruples; we took an Ounce, and having expos'd it at the ſame time with the *Calx* of Tin, and, for the ſame time, kept it in the Fire, we took it out at the two hours end; and found the weight to be increas'd two Drachms and two and twenty Grains. The filings were very hard bak'd together, and, the Lump being broken, looked almoſt like Iron.]

EXPER. XXI.

The following Experiment, though it may ſeem in one regard but a Continuation of the XVth; yet it has in this ſomething peculiar from all the foregoing, that not only it affords an inſtance of the increaſe of Weight obtain'd by a Metal at the ſecond

time of its being expos'd to the fire, but ſhews alſo, that ſuch an increment may be had, though this ſecond ignition be made in *cloſe* Veſſels.

[Some of the Copper mention'd in *Experim.* XV. being accidentally loſt, one Ounce and four Drachms of what remain'd was included betwixt two Crucibles and expos'd to a ſtrong fire for two hours, and ſuffer'd to continue there till the fire went out: When it was taken out, it appear'd to have gain'd ten Grains in weight, and to have upon the ſuperficial parts of the Plates (as we obſerv'd) divers dark colour'd flakes, ſome of which ſtuck to the Metal, but more, upon handling it, fell off.]

And here I ſhall conclude One of the Two Parts of our deſigned Treatiſe: For, though I remember, that theſe were not all the Tryals that were made and ſet down upon the Subject hitherto treated of; yet theſe are the chief, that having eſcaped the miſchances, which befel ſome others,

others, I can meet with among my promiſcuous Memorials; whoſe number, when I drew them together, I could ſcarce increaſe, having by all theſe and other Tryals of differing kinds waſted my Cupels and commodious Glaſſes, where I could not well repair my loſs. Whether I ſhould have been able by Reduction, ſpecifick Gravity, or any other of the ways, which I had in my thoughts, to make any diſcovery of the Nature of the Subſtance that made the Increment of Weight in our Ignited Bodies; the want as well of leiſure, as of accommodations requiſite to go through with ſo difficult a task, keeps me from pretending to know. But theſe three things, I hope, I may have gained by what has been deliver'd. The *Firſt*, That we ſhall henceforth ſee cauſe to proceed more warily in the Experiments we make with Metals in the Fire, eſpecially by Cupellation. The *next*, That it will juſtifie and perhaps procure an eaſier aſſent to ſome paſſages in my

other Writings, that have Relation to the Subſtance, what-ever it be, that we are ſpeaking of. And the *third*, (which is the principal,) That it will probably excite you, and your inquiſitive Friends, to exerciſe their ſagacious Curioſity, in diſcovering what kind of Subſtance that is, which, though hitherto overſeen by Philoſophers themſelves, and, being a Fluid, far more ſubtile than viſible Liquors, and able to pierce into the Compact and Solid Bodies of Metals, can yet add ſomething to them, that has no deſpicable Weight upon the Ballance, and is able for a conſiderable time to continue fixt in the Fire.

Addi-

Additional Experiments, ABOUT ARRESTING and WEIGHING OF Igneous Corpuscles.

EXperiments to diſcover the Increaſe in Weight of Bodies, though inclos'd in Glaſſes, being thoſe that I conſidered as likelieſt to anſwer what I deſign'd in the hitherto proſecuted Attempt, and finding the ſeventeenth *Experiment* as well as the next (try'd upon Mercury) to be very ſlow, and its performance not to be very great, I began to call to mind, what, many years ago, Experience had ſhewn me poſſible to be perform'd, as to the managing Glaſs-veſſels, even without coating them, in a naked Fire, pro-

provided a wary person were constantly employ'd to watch them. And supposing hereupon, that, in no longer time than a Laborant might, without being tir'd, hold out to attend a Glass, a Metal expos'd in it to a naked fire might afford us a much more prosperous tryal than that lately referr'd to, I afterwards resolv'd, when I should be able to procure some Glasses conveniently shap'd, to prosecute my Design; in pursuance of which though I had not any Furnaces fitted for my purpose, I directed a Laborant to make the following Tryals.

EXPER. I.

[We took eight Ounces (*Troy* weight) of Block-Tin, which being cut into bits was put into a good round Vial with a long neck, and then warily held over quick Coals without touching them till it was melted; after which it was kept almost continually shaken, to promote the Calcination, near an hour; the Metal

Metal being all the while in fuſion, and the Glaſs kept at ſome diſtance from the throughly kindled Coals. The moſt part of this time the orifice of the Vial was cover'd with a Cap of Paper (which ſometimes fell off by moving the Glaſs) to keep the Air and Steams of the Coals from getting into the neck. And at the end of this time, he that held the Glaſs being tir'd, and having his Hand almoſt ſcorch'd, the Vial being remov'd from the fire was broken, that we might take out the Metalline Lump, which had a little darkiſh *Calx* here and there upon the upper ſurface, but much more beneath, where it had been contiguous to the bottom of the Glaſs; then putting all this carefully freed from little fragments of broken Glaſs into the ſame Ballance with the ſelf-ſame counterpoiſe I had us'd before, I found, according to my Expectation, an increaſe of weight, which amounted to eighteen Grains, that the Tin had acquir'd by this Operation.]

EXPER.

EXPER. II.

[This done we ſeparated the *Calx* for fear of loſing it, and having melted the Metal in a Crucible, that by pouring it out it might be reduc'd to thin Plates capable of being cut in pieces, and put into ſuch another Vial as the laſt; we weigh'd it again together with the lately reſerv'd *Calx*, but found, that, notwithſtanding all our care, we had loſt three Grains of the eighteen we had gain'd. This done we put the Metal into another Vial. But in regard the neck was ſhorter than that of the former, and could not like it be long held in ones Hand; and becauſe alſo I was willing to ſee what Intereſt the ſhaking of melted Tin has in the quickneſs of the Calcination, the Glaſs, which had a ſtopple of Paper put to it to keep out Smoak and Air, was held at ſome diſtance from the Coals, only whilſt the Tin was melting; and then was warily laid upon

upon them and kept there for two hours; at the end of which 'twas again taken off, and the Metal weigh'd with the ſame Counterpoiſe and Ballance as formerly; and then it appear'd to amount to eight Ounces twenty-four Grains, and to have much more ſeparable *Calx* than at the firſt time. Nor did I much wonder, that the weight ſhould be increas'd in this laſt Operation but nine Grains in two hours, and in the former twice ſo many in half the time; ſince, during the two hours, the Glaſs was kept in one poſture, whereas in the firſt Operation, it was almoſt perpetually ſhaken all the while 'twas kept in fuſion. And 'tis obſerv'd, that the agitation of melted Minerals will much promote the Effect of the Fire upon them, and conduce to their Calcination.]

EXPER. III.

Though theſe Tryals might well ſatisfie a perſon not very ſcrupulous, yet

yet to convince even those that are so, I undertook, in spite of the difficulties of the Attempt, to make the Experiment in Glasses Hermetically seal'd, to prevent all suspition of any accession of Weight accruing to the Metal from any Smoak or Saline Particles getting in at the mouth of the Vessel. And in prosecution of this design I thought upon a way of so Hermetically sealing a Retort, that it might be expos'd to a naked fire without being either crackt or burst; an Account of which Tryal was thus set down.

[Eight Ounces of good Tin carefully weigh'd out was Hermetically seal'd up in a new small Retort with a long neck, by which 'twas held in ones Hand, and warily approach'd to a kindled Charcoal-fire, near which the Metal was kept in fusion, being also ever now and then shaken for almost half an hour, in which time it seem'd to have acquir'd on the surface such a dark colour as argued a beginning of Calcination, and it both

both emitted Fumes that play'd up and down, and alſo afforded two or three drops of Liquor in the neck of the Retort. The Laborant being not able to hold the Glaſs any longer, 'twas laid on quick Coals, where the Metal continued above a quarter of an hour longer in fuſion; but before the time was come that I intended to ſuffer it to cool in order to the removing it, it ſuddenly broke in a great multitude of pieces, and with a noiſe like the Report of a Gun; but (thanks be to God) it did no harm neither to me nor others that were very near it. In the neck we found ſome drops of a yellowiſh Liquor, which a *Virtuoſo* that taſted it affirm'd to be of an odious but peculiar Sapor; and as for the Smell, I found it to be very ſtinking, and not unlike that of the diſtill'd Oyl of Fiſh.]

But, though our firſt Attempt of this kind had thus miſcarried, we were not thereby diſcourag'd, but in proſecution of the ſame deſign made the enſuing Tryal.

EXPER.

EXPER. IV.

[The Tin which had been before (in the firſt or ſome ſuch Experiment) partly calcin'd in a Glaſs, being melted again in a Crucible, that it might be reduc'd to pieces ſmall enough to be put into another Glaſs, was put again into the Scales, and the ſurpluſage being laid aſide, that there might remain juſt eight Ounces, theſe were put into a Bolt-head of white Glaſs with a neck of about twenty Inches long, which being Hermetically ſeal'd (after the Glaſs had been a while kept over the fire, leſt that ſhould break by the rarefaction of the Air,) the Metal was kept in fuſion for an hour and a quarter, as (being hinder'd by a Company of ſtrangers from being there my ſelf) the Laborant affirm'd. Being unwilling to venture the Glaſs any longer, it was taken from the fire, and when 'twas grown cold, the ſeal'd end was broken off; but before

I would

I would have the bottom cut out, I obſerv'd, that the upper ſurface of the Metal was very darkly colour'd, and not at all ſmooth, but much and very odly aſperated; and the lower part had between the bottom and the lower part of the Lump a pretty deal of looſe dark-colour'd *Calx*; though the neighbouring ſurface and ſome places of the Lump it ſelf look'd by Candle-light (it being then Night) of a golden Colour. The Lump and *Calx* together were weigh'd in the ſame Scales carefully, and we found the weight to have increas'd twenty-three Grains and better, though all the *Calx*, we could eaſily ſeparate, being weigh'd by it ſelf amounted not to four Scruples or eighty Grains.]

For Confirmation of this Experiment I ſhall ſubjoyn another, wherein but a quarter of ſo much Metal was employed with ſuch ſucceſs as the annexed Memorial declares.

EXPER. V.

[Two Ounces of filings of Tin were carefully weigh'd and put into a little Retort, whose neck was afterwards drawn slenderly out into a very small *Apex*; then the Glass was plac'd on kindled Coals, which drove out fumes at the small orifice of the neck for a pretty while. Afterwards the Glass, being seal'd up at the *Apex*, was kept in the fire above two hours; and then being taken off was broken at the same *Apex*; whereupon I heard the outward Fire rush in, because when the Retort was seal'd the Air within it was highly rarified. Then the body of the Glass being broken, the Tin was taken out, consisting of a Lump, about which there appear'd some gray *Calx* and some very small globuls, which seem'd to have been filings melted into that form. The whole weigh'd two Ounces twelve Grains, the later part of which weight appear'd to have been gain'd by the Operation of the Fire on the Metal.

Metal. In the neck of the Retort, where it was joyn'd to the body, there appear'd a yellowish and clammy substance thinly spread, which smelt almost like the fœtid Oyl of Tartar.]

EXPER. VI.

To vary the foregoing Experiments by making Tryals on a Mineral that is held to be of a very Metalline nature, but is not a true Metal, nor will be brought to fusion by so moderate a Heat as will suffice to melt Tin, and yet has parts less fixt than Tin, as being far more easily sublimable, we thought fit to make the following Experiment.

[We took an Ounce of filings of *Zinke* carefully weigh'd, and having as carefully put them into a round Bolt-glass, we caus'd the neck to be drawn out very slender, and then order'd the Laborant to keep it upon quick Coals for the appointed time. Afterwards returning home, I call'd for the Glass; which he said he had

kept four hours upon the Coals, answering me also, that there did for a great part of the time Smoak appear to ascend from the *Zinck* and get out at the unstopt *Apex*. And in effect I observ'd, that the upper part of the Glass was lin'd with *Flores* or Sublimate of a darkish gray. The Glass being dextrously cut asunder, we took out not only the filings of *Zinke*, some of which were melted into little globuls, but the *Flores* too, and yet weighing all these in the same Scales, we had us'd before, we found five Grains and somewhat better wanting of an Ounce. Which we the les wonder'd at, because of the continuance of the lately mention'd Exhalations emitted by the filed Mineral.]

EXPER. VII.

For more ample confirmation of the truth discover'd by what I have been reciting about Tin, I thought fit to try the like Experiment upon another Metal, which though of some-

ſomewhat more difficult fuſion than Tin, I had reaſon to think might, if employed in a moderate quantity, and warily managed, be kept melted in Glaſs without breaking it. And accordingly having carefully weigh'd out four Ounces of good Lead cut before-hand into pieces little enough for the orifice of the Glaſs, I cauſed them to be put into a ſmall Retort with a long neck, wherein was afterwards left but an orifice not much bigger than a pins head: Then leaving directions with the Laborant what to do, becauſe I was my ſelf call'd abroad, at my return he brought me together with the Glaſs, this Account: That he had kept it over and upon the Coals two hours, or better, and then ſuppoſing the danger of breaking the Glaſs was over, he had ſealed it up at the little Orifice newly mention'd, and kept it on the Coals two hours longer. Before the Glaſs (which I found to be well ſeal'd) was broken, I perceived the pieces of Lead to have been melted into a Lump, whoſe

ſurface was dark and rugged, and part of the Metal to have been turn'd into a dark-colour'd Powder or *Calx*: All this being taken out of the Retort, was weigh'd in the ſame Ballance, whereon the Lead appear'd to have gain'd by the Operation ſomewhat above thirteen Grains.

EXPER. VIII.

To ſhew that Metals are not the only Bodies that are capable of receiving an increaſe of Weight from the Fire, I thought fit to make upon Coral a tryal, whereof my Memorial gives me this Account.

[Little bits of good red Coral being Hermetically ſeal'd up in a thin bubble of Glaſs, after two Drachms of them had been weigh'd out in a pair of nice Scales, were warily kept at ſeveral times over and upon kindled Coals, and at length being taken out for good and all, were found of a very dark Colour, and to have gain'd in weight three Grains and about a half.]

EXPER.

EXPER. IX.

One Experiment there is, which, though it might have come in more properly at another place, is not to be omitted in this, becauſe it may invite us to conſider, whether in the foregoing Experiments, excepting thoſe made on Lead and Tin in ſeal'd Veſſels, there may not be more of the Fire adherent to or incorporated with the Body expos'd to it, than one would conclude barely from the recited Increments of their Weight. For having taken very ſtrong freſh Quick-lime provided on purpoſe for choice Experiments, and expos'd it, before the Air had time to ſlake it, upon the Cupel, to a ſtrong fire where it was kept for two hours; I found that it had increas'd in weight even ſomewhat beyond my expectation: For being ſeaſonably put into the Ballance, the Lumps that weigh'd, when expos'd, but two Drachms, amounted to two

Drachms and twenty-nine Grains; which makes this Experiment a pregnant one to our purpose. For by this it appears, that notwithstanding a Body may for many hours, or even for some days, be expos'd to a very violent Fire, yet it may be still capable of admitting and retaining fresh Corpuscles; so that, though well made Lime be usually observ'd to be much lighter than the Stones whereof 'tis made; yet this lightness does not necessarily prove, that, because a burnt Lime-stone has lost much of its matter by the Fire, it has therefore acquir'd no matter *from* the Fire; but only inferrs, that it has lost far more than it has got. And this may give ground to suspect, that in most of the foregoing tryals the accession of the fiery Particles was greater (though in some more, in others less so,) than the Ballance discover'd; since, for ought we know, divers of the less fixt Particles of the expos'd Body might be driven away by the vehemence of the Heat; and con-

conſequently the Igneous Corpuſcles that faſtned themſelves to the remaining matter might be numerous enough, not only to bring the acceſſion of Weight that was found by the Scales, but to make amends for all the fugitive Particles, that had been expell'd by the violence of the Fire. And ſince ſo fixt a Body as Quick-lime is capable of being wrought upon by the Igneous *Effluvia*, ſo as that they come to be as 'twere incorporated with it, it may perchance be worth conſidering, whether in other calcin'd or incinerated Bodies the remaining *Calces* or Aſhes may not retain more than the bare Impreſſion (unleſs that be ſtretch'd to mean ſome participation of a ſubſtance,) of the Fire. Whether theſe Particles that adhere to or are mingled with the ſtony ones of the Lime may have any thing to do in the Heat and tumult that is produc'd upon the ſlaking of Lime, this is not a fit place to examine. And *though* by this Experiment and thoſe made in

in ſeal'd Retorts, which ſhew that what is afforded by Fire may in a Corporeal way invade, adhere and add Weight to even fixt and ponderous Bodies, there is a large Field open'd for the Speculative to apply this Diſcovery to divers *Phænomena* of Nature and Chymiſtry; *yet* I ſhall leave this Subject unmedled with in this place.

A DISCOVERY Of the PERVIOUSNESS OF GLASS To PONDERABLE PARTS OF FLAME:

With ſome Reflexions on it by way of *COROLLARY.*

Subjoyned as an Appendix *to his Experiments about* Arreſting *and* Weighing *of* IGNEOUS CORPUSCLES.

BY

The Honorable ROBERT BOYLE.

LONDON:
Printed by *W. G.* for *M. Pitt* at the ſign of the *Angel*, over-againſt the little North Door of St. *Paul's* Church, 1673.

The Printer to the Reader.

IT hath been thought, it might be the Intereſt of the Reader, *eſpecially* Foreiners, *to be adverti ſed, That theſe Eſſays are already Tranſlating into* Latin, *and beginning alſo to be Printed in that Language; which that it may duly be done, both as to this and the Author's other Writings, to be publiſhed for the future, the greater care will be taken here, becauſe it hath been ſeveral times found both at home and elſewhere, that the Verſions made of them abroad, and not in the place, where in caſe of any difficulty the Author may be conſulted with by the* Latin Interpreters, *are often very defective, and not ſeldom injurious to the ſenſe he hath deliver'd them in. Which being conſider'd by thoſe that deſire to know the genuine ſenſe of the Author, 'tis preſumed, they will rather chooſe thoſe* Verſions, *which are made by perſons that have that advantage of conſulting him in any caſe of doubt, than ſuch as ſhall mis-inform them; notwithſtanding the pretence of a cheaper rate of the Book.*

Which being thus adverti ſed, the Printer *taketh this opportunity of farther acquainting the* Reader *from the* Latin Interpreter, *that theſe Eſſays, to his knowledge, were ready and*

and in the Press several Months before Dr. Thomas Bartholin's Acta Philosophica & Medica *appear'd in* English, *in which there are two or three passages that may seem of affinity with some to be met with in the latter part of the Papers about Experiments of* Arresting the parts of Flame, *and of* making them Ponderable.

The Reader is also desired to take notice, That in what the Author has written about the Perviousness of Glass, *he was content to suppose with Chymists and Physicians, that Glass Vessels contribute nothing of their matter to the Bodies that are prepared in them. And though he knew, as appears by the* 61, *and* 62 *Pages, it might possibly be alleaged, that the Weight gain'd by the included Metal was lost by the Glass; yet he declin'd inlarging on a surmise, all whose possible Cases could not in few words be well examin'd, and would probably be thought too Sceptical, and therefore Impertinent or Tedious to be discuss'd.*

A DISCOVERY OF The Perviousness of GLASS TO *Ponderable Parts of* FLAME.

THAT I might obviate some needless scruples that may be entertain'd by suspitious Wits upon this Circumstance of our Additional Experiments, *That the Glasses employ'd about them were not exposed to the Action of mere Flame, but were held upon Charcoals*, (which to some may seem to contain but a Grosser kind of Fire:) And *that* also I might, by diversifying the way of tryal, render such Experiments *both* more fit to afford Corollaries, *and* more serviceable to my other purposes, I attempted to make it succeed with a Body so thin and disingaged from

from gross matter as mere Flame is allowed to be, knowing, that by going cautiously with it to work, one might handle a Retort without breaking it, in spite of a violent agitation of kindled matter.

EXPER. I.

Supposing then that good common Sulphur by reason of its great Inflammability and the vehemency and penetrancy of its Flame, would be a very fit fuel for my purpose, I provided a small double Vessel so contrived, *that* the one should contain as many Coals as was necessary to keep the Sulphur melted, and *that* the other, which was much smaller, and shap'd like a Pan, should contain the Brimstone requisite for our Tryal; and (lastly,) *that* these two should be with a convenient Lute so joyned to one another, that all being clos'd at the top, save the orifice of the little Pan, (the fire and smoak of the Coals having their vent another way,)

way,) no fire ſhould come at the Retort to be employed, but the flame of the burning Brimſtone. Then two ounces of filings of Tin being heedfully weigh'd out, and put into a Glaſs-Retort provided for ſuch Tryals, and made fit to be eaſily ſeal'd up at the neck, when the time ſhould be convenient, the Sulphur (which ought to be of the purer ſort) was kindled, and the Glaſs by degrees expoſed to it; where it continued, as the Laborant inform'd me, (the ſmell of Brimſtone, peculiarly offenſive to me, forbidding me to be preſent,) near two hours before the Metal melted; after which he kept the Retort near an hour and half more with the Metal melted in it. Then bringing it me to look upon, I perceived a pretty deal of darkiſh *Calx* at the bottom, and partly too upon the ſurface of the far greater part of the Metal, which now lay in one Lump. The part of the Retort that had been ſeal'd being broken off, we firſt took out the *Calx*, and then

the

the Lump, and putting them into the Scales, they had been formerly weigh'd in, found them to have made a very manifeſt acquiſt of weight, which, if both the Laborant and I be not miſtaken, (for the paper, which ſhould inform us, is now miſſing) amounted to four grains and a half, gained by the recited Operation. Afterwards, we being grown more expert in making ſuch Tryals, the experiment was repeated with the ſame quantity of filings of the ſame Metal: At the end of the Operation, (which in all laſted ſomewhat above three hours) having broken off the ſeal'd neck of the Retort, we found, that a good proportion of dark-colour'd *Calx* had been produc'd. This being weighed with the uncalcin'd part of the Metal, the two ounces we firſt put in appear'd to have acquir'd no leſs than eleven grains and a half (and ſomewhat better.)

Such Superſtructures, both for number and weight, may poſſibly in

in time be built on this and the like Experiments, that I ſhall venture to obviate even ſuch a ſcruple as is like to be judg'd too Sceptical. But I remember, that, conſidering upon occaſion of ſome of the Experiments formerly recited, that though it were very improbable; yet it did not appear impoſſible, that the increment of Weight, acquir'd by Bodies expos'd in Glaſs-veſſels to the Fire, might proceed, not from the Corpuſcles of Fire; but from the Particles of the Glaſs it ſelf, looſened by the power of ſo intenſe a Heat, and forcibly driven into the inclos'd Body; I was content to take a couple of Glaſſes, whereof one was ſhap'd into a little Retort, and having weigh'd them, and then having kept them for a conſiderable time upon kindled Coals, and then weigh'd them again, I could gather little of certainty from the Experiment; (the Retort at one time ſeeming to have acquir'd above half a grain in the fire;) ſave that there was no likelihood at all, that

so considerable an increase of weight, as we divers times obtain'd in close vessels, should proceed from the Glass it self, and not from the Fire.

EXPER. II.

Because it seems evident enough, that, whatever Chymists tell us of their Hypostatical Sulphur, common Brimstone is a body Heterogeneous enough, having in it some parts of an oyly or inflammable nature, and others acid, and very near of kin to the Spirits of Vitriol; I thought fit to vary our Experiment, by making it with a liquor that is generally reputed to be as Homogeneous as Chymists themselves are wont to render any, I mean with a Spirit of Wine, or some such liquor as will totally flame away without affording Soot, or leaving any drop of Phlegm behind it. In prosecution of this design, we carefully weighed out an ounce of filings of Block-Tin, and put them into a Glass-Retort, fit for the

the purpose, whose neck was afterwards drawn out to a great slenderness; and we also provided a conveniently shap'd metalline Lamp, such as that the flame of this ardent Spirit might commodiously burn in it, and yet not melt nor crack it; which Lamp, though furnished with a Cotton wick, afforded no Soot, because as long as it was supplied with liquor enough, it remained unburnt. These things being in readiness, the Retort was warily approach'd to the flame, and the Metal was thereby in a short time melted. After which the Glass being kept expos'd to the same flame for near two hours in all, the seal'd *apex* of the Retort was broken off; and there appear'd to have been produc'd a not inconsiderable Quantity of *Calx*; that lay loose about the remaining part of the Tin, which, upon its growing cold, was harden'd into a Lump. This, and the *Calx*, being taken out of the Retort with care, that no little fragment of Glass

ſhould at all impoſe upon us, was weigh'd in the ſame Scales as formerly, and found to have gain'd four grains and a half, beſides the Duſt that ſtuck in the inſide of the Retort, of which we reckon'd enough to make about half a grain more; ſo that of ſo fine and pure a flame as of this totally ardent Spirit, enough to amount to five grains was arreſted, and in good meaſure fixt by its operation on the Tin it had wrought upon.

EXPER. III.

For confirmation of the former tryal, wherein we had imployed the *Spiritus ardens* of Sugar, we made the like experiment with highly Rectified Spirit of Wine, only ſubſtituting an ounce of Lead inſtead of one of Tin. The event, in ſhort, was this; that after the Metal had been for two hours or better kept in the flame, the ſeal'd neck of the Retort being broken off, the external Air

Air ruſh'd in with a noiſe, (which ſhew'd the Veſſel to have been very tight,) and we found pretty ſtore of the Lead; for 'twas above ſeven ſcruples, turn'd into a grayiſh *Calx*, which together with the reſt of the Metal being weigh'd again, there was very near, if not full, ſix grains of increaſe of weight acquir'd by the Operation.

1. *N. B.* The Lump of Lead, that remain'd after the newly recited Operation, being ſeparated from the *Calx*, was weighed and cut in pieces, that it might be put into a freſh Retort, wherein it was again expos'd to the flame of Spirit of Wine, that I might ſatisfie my ſelf, whether probably the whole Body of the Lead might not, by repeated Operations, or (perhaps by one continued long enough) be reduc'd to *Calx*. And though, after the Retort (whoſe neck had been drawn out) had been kept in the flame for about two hours, it was, by the negligence of a Foot-boy, unluckily broken, and ſome of

the *Calx* loſt; yet we made a ſhift to ſave about five grains of it, (whoſe colour was yellowiſh;) which was enough to make it likely, that, if we had had conveniency to purſue the Operation to the utmoſt, the whole Metal might have been calcin'd by the action of the flaming Spirit.

2. *N. B.* And leſt you ſhould be induc'd by ſome Chymical conceits to imagine, that the particles that once belong'd to flame, did make more than a Coalition with thoſe of the Lead, and by a perfect Union were Really tranſmuted into the Metal whoſe weight they increas'd; I ſhall add, that (according to a Method elſewhere deliver'd) I examin'd the *ſeven ſcruples* of *Calx*, mention'd to have been made in the third Experiment, by weighing them in Air and Water, and thereby found, as I expected, that though the *abſolute* Gravity of the Metal had been increas'd by the particles of Flame that ſtuck faſt to it, yet this Aggre-

gate

gate of Lead and extinguish'd Flame had lost much of its *specifick* Gravity. For, whereas Lead is wont to be to Water of the same bulk, as about *eleven* and a *half* to *one*, this subtil *Calx* of Lead was to Water of the same bulk little, if at all, more than as *nine* to *one*.

These are not the only Experiments I made of the Operation of meer Flame upon Bodies inclos'd in Glasses; but these, I suppose, are sufficient to allow me to comply with my present haste, and yet make good the *Title* prefixt to this Paper. For, whence can this increase of *absolute* weight (for I speak not of *specifick* Gravity,) observ'd by us in the Metals expos'd to the mere flame, be deduc'd, but from some ponderable parts of that Flame? And how could those parts invade those of the Metal inclos'd in a Glass, otherwise than by passing through the pores of that Glass? But, because I judge it unphilosophical, *either* to be more careful that what one writes should *appear* strange, than *be* true;

or to be forward to advance the repute of Strangeness, to the prejudice of the Interest of Truth, though it be perhaps but a remote one, or a collateral one; I shall deal so impartially, as to subjoyn on this occasion two or three short Intimations, that may prove *both* seasonable for Caution, in reference to the Porousness of Glass, *and* give a hint or two in relation to other Things.

I do not then by the foregoing Experiments pretend to make out the Porosity of Glass any farther, than is expresst in the *Title* of this Paper; namely, in reference to some of the Ponderable parts of Flame. For otherwise I am not at all of their mind, that think Glass is easily penetrable, *either*, as many do, by Chymical Liquors; *or*, as some, by Quicksilver; *or*, as others, at least by our Air: Those opinions not agreeing with the Experiments I made purposely to examine them, as you may find in another Paper.

Again, if we compare the Increase

we

we observe to be made in the Weight of the Bodies that we expose to the naked Fire, and those of the same or the like kinds that we included in Glasses, or so much as in Crucibles; it may be worth considering, Whether this difference in acquir'd weight may not give cause to suspect, that the Corpuscles, whereof Fire and Flame consists, are not all of the same size, and equally agitated, but that the interpos'd Vessel keeps out the grosser Particles like a kind of Strainer, though it gives passage to the minutest and most active?

I offer it also to Consideration, Whether this perviousness of Glass, even to the minute particles that pervade it, and their adhesion to the Metal they work on, does necessarily imply Pores *constantly* great enough to transmit such Corpuscles? or, Whether it may not be said, *that* Glass is generally of a closer Texture, than when in our Experiments the pores are open'd by the vehement Heat of the flame that beats upon it,

and

and in that ſtate may let paſs Corpuſcles too big to permeate Glaſs in its ordinary ſtate; and *that* this penetration is much aſſiſted by the vehement agitation of the Igneous parts, which by the rapidneſs of their motion both force themſelves a paſſage through the narrow pores of the Glaſs, and pierce deep enough into thoſe of the included Body to ſtick faſt there; (as hail-ſhot thrown with ones hand againſt a board, will paſs off from it, but being ſhot out of a Gun will pierce it, and lodge themſelves in it:) And I know a *Menſtruum* that does not work upon a certain Metal whilſt the liquor is cold, or but faintly heated, and yet by intending the Heat would be made to turn it into a powder or *Calx*, (for it does not properly diſſolve it.)

Perhaps it may not be amiſs to add on this occaſion, that though Glaſs be generally acknowledged to have far ſmaller pores, than any other matter wont to be implyed to make veſſels, that are to be expos'd

to

to the fire; yet till I be farther ſatisfy'd, I ſhall forbear *both* to determine, whether the rectitude, that ſome Philoſophers ſuppoſe in the pores of Glaſs, as 'tis a tranſparent body, or rather in their ranks or rows, may facilitate the Perviouſneſs we above obſerv'd in Glaſs, *and* to conclude from the foregoing Experiments, that ponderable parts of Flame will be able as well to paſs through the pores of Metalline veſſels as thoſe of Glaſs. For though, with a ſilver veſſel, made merely of plate without Soder, I made two or three Tryals (of which you may command an account) in order to the reſolving of theſe doubts; yet by an accident, which, though it were not a ſurprizing one, was unlucky enough to defeat my endeavours, I was kept, for want of fit Accommodations, from bringing my intended tryals to an iſſue.

And now having endeavour'd by the foregoing Advertiſements to prevent the having unſafe Conſequences drawn

drawn from our Experiments; it remains that I briefly point at three or four *Corollaries* that may more warily be deduc'd from them. To which, if I get time, I may ſubjoyn a hint or two about further Inquiries.

COROLLARY I.

Confirming this PARADOX, That Flame may act as a Menſtruum, *and make Coalitions with the Bodies it works on.*

THE Experiments, we have made and recited of the permeating of Flame (as to ſome of its parts) through Glaſs-veſſels, and of its working on included Metals, may much confirm the Paradox I have elſewhere propos'd, That Flame may be a *Menſtruum*, and work on ſome Bodies at the rate of being ſo; I mean not only by making a notable Comminution and Diſſipation of the parts, but

but by a Coalition of its own particles with those of the fretted Body, and thereby *permanently* adding Substance and Weight to them. Nor is it repugnant to Flames, being a *Menstruum*, that in our experiment the Lead and Tin, expos'd to it, were but reduc'd to powder, and not dissolv'd in the form of a Liquor, and kept in that state. For, besides that the interpos'd Glass hinder'd the Igneous particles from getting through in plenty enough; I consider, that 'tis not necessary, that all *Menstruums* should be such Solvents, as the objection supposes. For *whether* it be (as I have sometimes suspected,) that *Menstruums*, that we think simple, may be compounded of very differing parts, whereof one may precipitate what is dissolved by the other; *or* for some other Cause, I have not now time to discuss. Certain it is, that some *Menstruums* corrode Metals and other Bodies without keeping dissolved all, or perhaps any considerable part; as may be seen, if you put Tin

in

in a certain quantity of *Aqua fortis*, which will in a very short time reduce it almost totally to a very white substance, which, when dry, is a kind of *Calx*. And so by a due proportion of Oyl of Vitriol, abstracted from Quicksilver by a strong fire, we have divers times reduc'd the main body of the Mercury into a white powder, whereof but an inconsiderable part would be dissoluble in water. And such a white *Calx* I have had by the action of another fretting Liquor on a Body not Metalline.

And having thus clear'd our Paradox of the oppos'd Difficulty, my haste would immediately carry me on to the next Corollary, were it not, that there is one *Phænomenon* belonging to this place that deserves to be taken notice of. For, *whether* it be, as seems probable, from the vehement agitation of the permeating particles of Flame, that violently tear asunder the Metalline Corpuscles, or from the nature of the Igneous *Menstruum*, (which being as 'twere percolated through

through Glass it self, must be strangely minute,) 'tis worth observing, how small a proportion, in point of weight, of the additional adhering Body may serve to corrode a Metal, in comparison of the Quantity of vulgar *Menstruums* that is requisite for that purpose. For, whereas we are oblig'd to imploy, to the making the solution of crude Lead, several times its weight of Spirit of Vinegar, and (though not so many times) even of *Aqua fortis*, 'twas observ'd in our Experiment, that, though the Lead was increas'd but six grains in weight, yet above six score of it were fretted into powder, so that the *Corrosive* Body appear'd to be but about the twentieth part of the *corroded*.

COROLL. II.

Proposing a PARADOX about Calcination and Calces.

Another Consequence, deducible from our discovery of the perviousness of

of Glaſs to Flame, may be this; That there is cauſe to queſtion the Truth of what is generally taken for granted about Calcination, and particularly of the notion, that not only others, but Chymiſts themſelves, have entertain'd about the *Calces* of Metals and Minerals. For, whereas 'tis commonly ſuppos'd, that in Calcination the greater part of the Body is driven away, and only the Earth, to which Chymiſts add the Fixt Salt, remains behind; and whereas even Mechanical Philoſophers, (for two or three of Them have taken notice of Calcination,) are of opinion, that much is driven away by the violence of the fire, and the remaining parts by being depriv'd of their more radical and fixt moiſture are turn'd into dry and brittle particles: Whereas theſe Notions, *I ſay*, are entertain'd about Calcination, it ſeems, that they are not well fram'd, and do not univerſally hold; ſince, at leaſt they are not applicable to the Metals, our Experiments were made on. For, it *does not* appear by

by our Tryals, that any proportion, worth regarding, of moist and fugitive parts was expell'd in the Calcination; but it *does* appear very plainly, that by this Operation the Metals gain'd more weight than they lost; so that the main body of the Metal remain'd intire, and was far from being, *either* as a *Peripatetick* would think, Elementary Earth, *or* a compound of Earth and Fixt Salt, as Chymists commonly suppose the *Calx* of Lead to be. From which very erroneous *Hypothesis* they are wont to inferr the sweet Vitriol of Lead, which they call *Saccharum Saturni*, to be but the sweet Salt of it *extracted* only by the Spirit of Vinegar, which does *indeed* plentifully enough concurr to *compose* it. Whence I conclude, that the *Calx* of a Metal even made (as they speak) *per se*, that is, by fire without additament, may be, at least in some cases, not the *Caput mortuum*, or *Terra damnata*, but a Magistery of it. For, in the sense of the most intelligible of the Chymical Writers, that is

properly a Magistery wherein the Principles are not separated, but the bulk of the Body being preserved, it acquires a new and convenient form by the addition of the *Menstruum* or Solvent imployed about the preparation. And, not here to borrow any Argument from my Notes about particular Qualities, you may guess, how true it is, that the greatest part of the Body, or all the radical moisture is expell'd in Calcination, which therefore turns the Metal into an arid unfusible powder; by this, That I have several times from *Calx* of Lead reduc'd corporal Lead. And I remember, that having taken what I guess'd to be but about a third or fourth part of the *Calx* of Lead, produc'd by the third Experiment; I found by a tryal purposely devis'd, that without any Flux-powder or any additament, but meerly by the application of the Flame of highly Rectified Spirit of Wine, there could in a short time be obtain'd a considerable proportion of malleable Lead;

whereof

whereof the part I had the Curiosity to examine, was true malleable Lead; so little was the arid powder, whence this was reduc'd, depriv'd by the foregoing Calcination of the suppo'sd radical moisture requisite to a Metal. The Consideration of what may be drawn from this Reduction in reference to the Doctrine of Qualities belongs not to this place.

COROLL. III.

One use, among the rest, we may make, by way of Corollary, of the foregoing Discovery, which is in reference to a Controversie warmly agitated among the Corpuscular Philosophers themselves. For, some of them, that follow the *Epicurean* or *Atomical Hypotheſis*, think, that when Bodies are expos'd in close vessels to the fire, though the Igneous Corpuscles do not stay with the Bodies they invade, yet they really get through the Pores of the interpos'd Vessels, and permeate the included

Bodies in their paſſage upwards; whereas others, eſpecially favourers of the *Carteſian* Doctrine, will not allow the *Atomiſts* Igneous Corpuſcles, which they take to be but vehemently agitated particles of Terreſtrial matter, to penetrate ſuch minute pores as thoſe of Glaſs; but do ſuppoſe the operation of the fire to be perform'd by the vehement agitation made of the ſmall parts of the Glaſs, and by them propagated to the included Bodies, whoſe particles by this violent Commotion are notably alter'd, and receive new Textures, or other modifications.

But our Experiments inform us, that, though neither of the two Opinions ſeems fit to be deſpiſed, yet neither ſeems to have hit the very mark; though the *Epicurean Hypotheſis* comprize ſomewhat more of the Truth than the other. For, though it be not improbable, that the brisk agitation communicated by the ſmall parts of the Glaſs to thoſe of the Body contain'd in it, may contribute much

to

to the effect of the fire; and though, by the ſmall increment of weight, we found in our expos'd Metal, 'tis very likely, that far the greater part of the Flame was excluded by the cloſe Texture of the Glaſs; yet on the other ſide 'tis plain, that Igneous particles were trajected through the Glaſs, which agrees with the *Epicureans*; and they, on the other ſide, miſtook, in thinking that they did but paſs through, and divide and agitate the included Bodies; to which nevertheleſs our Experiments ſhew, that enough of them, to be manifeſtly ponderable, did permanently adhere.

Whether theſe Igneous Corpuſcles do ſtick after the like manner to the parts of meat, dreſt by the help of the fire, and eſpecially roaſt-meat, which is more immediately expos'd to the action of the fire, may be a queſtion, which I ſhall now leave undiſcuſs'd, becauſe I think it difficult to be determin'd, though otherwiſe it ſeems worthy to be conſider'd, in regard it may concern mens Health,

to know, *whether* the Coction of meat be made by the fire, only as 'tis a very hot body, *or* whether it permanently communicates any thing of its substance to the meat expos'd to it: In which (last) case it may be suspected, that not only the degree and manner of application of a fire, but the nature of its fuel may be fit to be consider'd.

COROLL. IV.

The Experiments above recited give us this further Information, That Bodies very spirituous, fugitive, and minute, may, by being associated with congruous particles, though of quite another nature, so change their former Qualities, as to be arrested, by a solid and ponderous Body, to that degree, as not to be driven away from it by a fire intense enough to melt and calcine Metals.

For, the foregoing Tryals (taking in what I * lately deliver'd of the lessen'd specifick Gravity of calcin'd Lead) seems

* *Exp.* III. *N.B.* 2.

ſeems plainly enough to diſcover, that *even* the agitated parts of flame, minute enough to paſs through the pores of Glaſs it ſelf, were as 'twere entangled among the metalline particles of Tin and Lead, and thereby brought to be fixt enough to endure the Heat that kept thoſe Metals in fuſion, and little by little reduc'd them into *calces*: Which is a *Phænomenon* that one would not eaſily look for, eſpecially conſidering how ſimple a Texture that of Lead or Tin may be ſuppos'd to be in compariſon of the more elaborate ſtructures of very many other Bodies. And this *Phænomenon*, which ſhews us, what light and fugitive particles of matter may permanently concurr to the Compoſition of Bodies ponderous and fixt enough, may perchance afford uſeful hints to the Speculative; eſpecially if this ſtrict Combination of ſpirituous and fugitive ſubſtance with ſuch, as being groſs or unwieldy, are leſs fit than organiz'd matter to entangle or detain them, be applied, (as it

may be with advantage) to those aggregates of spirituous Corpuscles, and organical Parts, that make up the Bodies of Plants and Animals. And this hint may suggest a main Inference to be drawn from the Operations of the Sun-beams on appropriated subjects, supposing it to prove like that of flame on Tin and Lead.

And now having dispatch'd our *COROLLARIES*, we might here inquire, Whether all the particles of Fire and Flame, that are subtile and agitated enough to penetrate Glass, and fasten themselves to included Bodies, be reduc'd by Ignition to the same nature, or else retain somewhat of their proper Qualities? Which Inquiry I have some cause not to think so undeterminable, as at first blush it may appear. For, *one of the ways*, that may be propos'd for this *Examen*, is already intimated at the close of the third Experiment, which shews, that we may compare the specifick Gravity of the *Calces* of the same

ſame Metal, made in Glaſſes by the operation of Flames; whoſe fuels are of very differing Natures. And I ſaid, *one of the ways*, becauſe 'tis not the only way I could name, and have partly tryed. But though I might ſay more concerning Expedients of this kind, and could perhaps propound other Inquiries that may reaſonably enough be grounded upon the hitherto recited *Phænomena* (and thoſe of ſome other like tryals,) yet I muſt not unſeaſonably forget, that the purſuit of ſuch Diſquiſitions would lead me much farther than I have now the leiſure to follow it.

ERRATA.

Pag. 44. *l.* 19. *r.* ſome Metals work; *pag.* 1. *in the Diſcourſe* about the Determinate Nature of Effluviums, *add the name of the Author, viz.* By the Honorable *ROBERT BOYLE.*

FINIS.

The Printer to the Reader.

IT hath been thought, it might be the Intereſt of the Reader, eſpecially Foreiners, to be adverti ſed, That theſe Eſſays are already Tranſlating into Latin, and beginning alſo to be printed in that Language; which that it may duly be done, both as to this and the Author's other Writings, to be publiſht for the future, the greater care will be taken here, becauſe it hath been ſeveral times found both at home and elſewhere, that the Verſions made of them abroad, and not in the place, where in caſe of any difficulty the Author may be conſulted with by the Latin Interpreters, are often very defective, and not ſeldom injurious to the ſenſe he hath deliver'd them in. Which being conſider'd by thoſe that deſire to know the genuine ſenſe of the Author, 'tis preſumed, they will rather chooſe thoſe Verſions, which are made by perſons that have that advantage of conſulting him in any caſe of doubt, than

ſuch

such as shall mis-inform them; notwithstanding the pretence of a cheaper rate of the Book.

Which being thus advertised, the Printer *taketh this opportunity of farther acquainting the* Reader *from the* Latin Interpreter, *that these Essays, to his knowledge, were ready and in the Press several Months before Dr.* Thomas Bartholin's Acta Philosophica & Medica *appear'd in* England, *in which there are two or three passages that may seem of affinity with some to be met with in the latter part of the Papers about Experiments of* Arresting the parts of Flame, *and of* making them Ponderable.

A Catalogue of the Writings

Publiſht by

The Honorable *ROBERT BOYLE.*

1. *Seraphick Love.* London, *for* Henry Herringman, 1660. *in* 8°.

2. *New Experiments Phyſico-Mechanical, touching the Spring of the Air, and its Effects.* Oxford, *for* Thomas Robinſon, 1660. *in* 8°. *In Latin:* Oxford; *for the ſame*, 1661. *in* 8°.

3. *Certain Phyſiological Eſſays; to which is added, The Phyſico-Chymical Eſſay about the Differing parts, and Redintegration of Saltpeter; as alſo, the Hiſtory of Fluidity and Firmneſs.* London, *for* Henry Herringman, 1661. *in* 4°. *In Latin*; London, *by the ſame*, 1661. *in* 4°.

4. *Some Conſiderations touching the Style of the H. Scriptures.* London, *for* H. Herringman, 1661. *in* 8°.

5. *The Sceptical Chymiſt.* London, *for* John Crook, 1661. *in* 8°. *In Latin*; London, *for the ſame*, *in* 8°. 1662.

6. *A Defence of the Doctrine touching the Spring and Weight of the Air, againſt the Ob-*

Objections of Franciſcus Linus. London, *for* Tho. Robinſon, 1662. *in* 4°.

7. *An Examen of Mr* Hobbes *his* Dialogus Phyſicus de Natura Acris; *with an Appendix touching Mr.* Hobbes *his Doctrine of Fluidity and Firmneſs.* London, *for* Tho. Robinſon, 1662. *in* 4°.

8. *Uſefulneſs of Experimental Philoſophy.* Oxford, *for* Rich. Davies, 1663. *in* 4°.

9. *Experimental Hiſtory of Colours.* London, *for* H. Herringman, 1664. *in* 8°. *In Latin:* London, *for the ſame*, 1665. *in* 12°.

10. *Hiſtory of Cold. To which is added, an Examen of Antiperiſtaſis, and of Mr.* Hobbes *his Doctrine of Cold.* London, *for* John Crook, 1665. *in* 8°.

11. *Hydroſtatical Paradoxes.* Oxford, *for* Rich. Davies, 1666. *in* 8°. *In Latin*; Oxford, *for the ſame*, 1669. *in* 12°.

12. *Origine of Forms and Qualities.* Oxford, *for* Rich. Davies, 1667. *in* 8°. *In Latin*; Oxford, *for the ſame*, 1669. *in* 12°.

13. *Free Conſiderations about Subordinate Forms.* Oxford, *for* Rich. Davies, 1667. *in* 8°. *In Latin*; Oxford, 1669.

14. *Continuation of New Experiments Phyſico-Mechanical touching the Spring and Weight of the Air, and the Atmoſphere of Conſiſtent*

ſiſtent Bodies. Oxford, *for* Rich. Davies, 1669. *in* 4°.

15. *Of the Abſolute Reſt of Solid Bodies.* London, *for* H. Herringman, 1669. *in* 4°. *In Latin*; London, *for the ſame*, 1672. *in* 12°.

16. *Several Tracts*; viz. *An Introduction to the Hiſtory of Particular Qualities: Of Coſmical Qualities and Suſpitions: Of the Temperature of the Subterraneal and Submarine Regions: Of the bottom of the Sea.* Oxford, *for* Rich. Davies, 1671. *in* 8°. *In Latin*; London, *for the ſame*, 1672. *in* 12°.

17. *Small Tracts*; viz. *Of a Diſcovery of the admirable Rarefaction of the Air, even without Heat: New Obſervations about the Duration of the Spring of the Air: New Experiments touching the Condenſation of the Air by meer Cold, and its Compreſſion without Mechanical Engins: The admirably Differing Extenſion of the ſame Quantity of Air rarified and compreſſed.* London, *for* H. Herringman, 1670. *in* 4°. *In Latin*; London, *for the ſame*, 1670. *in* 12°.

18. *Of the Uſefulneſs of Natural Philoſophy, Tom.* 2. Oxford, *for* Rich. Davies, 1671. *in* 4°.

19. *An Eſſay about the Origine and Virtue of Gems.* London, *for* Moſes Pitt, 1672. *in* 8°. *In Latin*; London, *for the ſame*, 1673. *in* 12°.

20. *Se-*

20. *Several Tracts, containing New Experiments touching the Relation betwixt Flame and Air, and about Explosions: An Hydrostatical Discourse answering some Objections of Dr.* Henry More: *An Hydrostatical Letter, dilucidating an Experiment about a way of weighing Water in Water: New Experiments of the Positive or Relative Levity of Bodies under Water: Of the Air's Spring on Bodies under Water: About the differing Pressure of Heavy Solids and Fluids.* London, *for* Rich. Davies, 1672. *in* 8°.

21. *Essays, of the strange Subtilty, the great Efficacy, and the Determinate Nature of Effluviums. To which are annext, New Experiments to make Fire and Flame Ponderable; together with a Discovery of the Perviousness of Glass.* London, *for* Moses Pitt, 1673. *in* 8°.

22. *A Dialogue concerning the Positive or Privative nature of Cold; by a* Member of the R. Society: *And a Discourse about the Saltness of the Sea; and another of a Statical Hygroscope; together with some* Phænomena *of the force of the Air's Moisture. To which is added a Paradox about the Natural and Præternatural State of Bodies, especially the Air.* London, *for* Rich. Davies, 1673. *in* 8°.

AN ESSAY ABOUT THE ORIGINE & VIRTUES OF GEMS.

Wherein are Propos'd and Hiſtorically Illuſtrated ſome Conjectures about the Conſiſtence of the Matter of *Precious Stones*, and the Subjects wherein their chiefeſt Virtues reſide.

By the Honourable ROBERT BOYLE, *Eſq*; Fellow of the *ROYAL SOCIETY*.

LONDON,
Printed by *William Godbid*, and are to be ſold by *Moſes Pitt* at the *White Hart* in *Little Britain*, 1672.

THE PUBLISHER TO THE READER.

THe Philoſophy and Origine of Gems as well as theire Uſefulneſs and Virtues will, I am perſwaded be found, upon the attentive peruſal of this *Eſſay* it ſelf, ſo rationally and warily deliver'd therein, that there will need nothing to be ſaid in the praiſe of the Compoſure thereof. I dare venture, notwithſtanding

the Noble Author's modesty, to present it to the most Critical taste, without hanging out a Bush to it.

All I have to say in the publishing thereof, shall be the same, that was alledged by the English Interpreter of the Learned *Steno's* Prodromus to an intended *Dissertation* of his, concerning Solids naturally contained within Solids, printed the last year by *Moses Pitt* in *Little Britain*; where in the *English* Preface occurr passages to this effect, *viz.*

"That the Honourable Au-
"thor of this *Essay*, before he
"would see or hear any thing
"of that Prodromus of *Steno*,
"did upon occasion solemnly
"declare

"declare to the Author of that "Engliſh Verſion (who there "proteſts, that he ſpeaks it "*bona fide*,) the ſum and ſub- "ſtance of what is deduced "at large in this Tract; the "Manuſcript whereof the ſaid "Interpreter then ſaw, and re- "ceived it into his cuſtody "for publication: Which Sum "was this; *Firſt*, that the ge- "nerality of *Tranſparent* Gems "have been once Liquid Sub- "ſtances, and many of them, "whilſt they were either fluid, "or at leaſt ſoft, have been im- "bued with Mineral Tinctures, "that con-coagulated with them; "whence he conceives, that di- "divers of the real Qualities and "Virtues of Gems may be proba- "bly derived.

"*Secondly*, as for the *Opacous*
"Gems, and other Medical
"Stones, as *Blood-stones*, *Jaspers*,
"*Magnets*, *Emery*, &c. he esteems
"them to have, for the most
"part, been Earth (perhaps in
"some cases very much diluted
"and soft) impregnated with
"the more copious proportion
"of fine Metalline or other Mi-
"neral juices or particles; all
"which were afterwards reduced
"into the form of Stone by the
"supervenience (or the exalted
"action) of some already inex-
"istent petrescent Liquor or pe-
"trific Spirit, which he supposeth
"may sometimes ascend in the
"form of Steams; from whence
"may be probably deduced not
"only divers of the Medical Vir-

"tues

"tues of ſuch Stones, but ſome "of their other qualities, as Co- "lour, Weight, &c. and alſo ex- "plained, how it may happen, "what he hath (which he doubts "not but others have done alſo) "obſerv'd of Stones of another "kind, or Marchaſites, or even "Vegetable and Animal ſub- "ſtances, that have been found "incloſed in ſolid Stones; for as "much as theſe ſubſtances may "eaſily be conceived to have "been lodged in the Earth, whilſt "it was but Mineral Earth or "Mud, and afterwards to have "been, as 'twere, caſed up by the "ſupervenient petrific Agents "that pervaded it.

"Nor are theſe petreſcent "Liquors the only ones, to

"which he supposes that many "Fossils may owe their Origine "since he thinks, there may be "both *Metallescent* and *Mineral.* "*lescent* Juices in the bowels of "the Earth, and that sometimes "they may there exist and ope- "rate under the same Spirits and "Steams.

So far the *Preface* to that Translation; which is here repeated, to do right to this Noble Author, in the matter of the *Theory* relating to the Origine both of precious and other Stones. Which done, I shall keep the Curious Reader no longer from the Contentment, which he will doubtless find in the perusal of this *Essay*.

THE

THE PREFACE.

THat *the Scarcity, the Luſtre and the Precious neſs of Gems have made them in all ages to be reckon'd among the fineſt and choiceſt of Natures Productions, is generally granted. But whether the Books, that have been divulged of them, be anſwerable to the Nobleneſs of the Subject, ſeems not to me ſo unqueſtionable: For, as for the* Origine *of Gems; to ſay with* Ariſtotle *towards the cloſe of his third Book of* Meteors, *that a dry Exhalation,* ξηρὰ ἀναθυμίασις, *(whether) fiery or firing,* (ἐμπυρεύσα,) *makes, among other foſſils, the ſeveral kinds of unfuſible Stones: or to tell us, according to the more received Doctrine, that Gems are made of Earth and*

and Water finely incorporated & harden'd by cold; This, I say, is to put us off with too remote and indefinite generalities, and to found an explication upon Principles, which are partly precarious and partly insufficient, and perhaps also untrue. And as to the History of Gems, that has been so fabulously deliver'd, that especially among the Moderns, many learned men, Philosophers and Physitians, have, for the sake of so many improbable and sometimes impossible Virtues, that have been ascrib'd to Gems, been induc'd to deny them any Virtues at all. 'Tis true, that I am not altogether so severe, and that the esteem, that I find made by Learned men of the inquisitive Emperor Rudolfus's Physitian Boetius de Boot, makes me discriminate him and two or three modern Authors, that in Books, professedly made on other Subjects, have written incidentally of some Gems, from such notoriously fabulous Writers as Mizaldus, Albertus Magnus, (if his name be not injur'd by the imputation of a spurious Book) Baptista Porta, Kirannides (and some others that I forbear to name,) from whose Learning one would

would expect more wariness and Judgement. But though, for reasons elsewhere mention'd, I do not unreservedly think, that Pretious Stones, especially Opacous ones, can have no medical Virtues at all; yet when I consider'd, how difficult it was to assigne any thing that is possible and intelligible, (which I do not take a substantial form to be,) whence their Virtues may probably be derived, without giving some such account of the Origine of Gems themselves, as was not to be expected from the Followers of the Peripatetic, that is, the Received, Philosophy; I could not but wish, that something were attempted on that Subject according to the Principles of the Corpuscularian.

These things made me the less backward to comply with the Curiosity of my Friends, which put me upon the following Discourse, wherein I was content to try, what, without ransacking the Authors that had professedly written de Gemmis, the consideration of the Subject to be treated of, my natural propensity to take notice of Natures productions, and the tryals whereto these Considerations and Observations lead

lead me, would ſuggeſt to my Pen.

Whether my Conjectures and Ratiocinations be as new to others as to thoſe I chiefly wrote for, 'tis not my part to determine: Only I deſign'd to ſuit my Diſcourſe to the Phænomena *of Nature, without being ſollicitous with whom I diſagree'd or complyed. And therefore, though it ſhould happen, that ſome Conjectures of mine ſhould, unknown to me, be coincident with the opinion of ſome Claſſic Writer about Gems; yet I preſume, the whole ſubſequent* Hypotheſis *and the Arguments 'tis founded upon, will appear to have been ſuggeſted to me by the nature of the thing it ſelf, and my way of conſidering it: not to mention, that ſometimes one may meet with a good particular Conjecture in an Author, that underſtands not the importance of it himſelf, and knows not how to make uſe of it, but builds it on ſome ſuch fabulous Relation or erroneous Principle, as is apt to diſcredit it with wary Readers, unleſs they be ſuch, to whom its complyance with the Opinions, they have on better grounds already entertain'd, happen to*

recommend

recommend it. I know, it may be thought ſtrange, that I have been ſo very ſparing in the Citation of thoſe Authors, that have writ whole Books about Gems; but I have this to ſay for my ſelf, that I had neither them, nor ſo much as my own Papers about the Origine of Minerals at hand, when I writ the following Eſſay. Which I was the leſs troubled at upon two diſtinct accounts; the firſt, becauſe I remember'd, that ſeveral paſſages, that I had met with about the Virtues of Gems, cited out of divers of thoſe Authors, were ſuch as I ſhould have much ſcrupled to vouch; ſome of them being ſuch as I knew to be falſe; others, that I ſhrewdly ſuſpected not to be true; and others, that appear'd to me altogether incredible: And the ſecond, becauſe, to forbear tranſcribing, what my Friends might probably have met with in Authors already, would beſt comply, both with their Deſires, which was to know my particular thoughts; and with my deſign, which was partly to ſee, how far I could make out thoſe thoughts by my own Arguments and Obſervations, aſſiſted only by ſome very few hiſtorical

paſſages,

passages, that I lighted on in Writers not Classic; and partly, *to take this occasion to prosecute divers matters of Fact relating to the subject I was treating of, which probably would otherwise have been quite lost. And I doubted not, but if this first draught of my Conceptions were by my Friends thought worthy of being inlarged, it would not be difficult for me, when I should come at my Books and Papers again, to inrich this Tract with many Histories borrow'd from famous Writers; if that should be thought necessary by persons, that were possibly less diffident of me than of them. In short; I propos'd this Discourse but as a Conjectural* Hypothesis, *wherein I attempted to derive the Origine of Gems and one of the* main *Causes, (I do not say, the* only *Cause) of their Qualities and Virtues, from Principles less remote, and more intelligible than those of the* Peripateticks; *and having deliver'd divers Observations and Experiments of my own about the* Phænomena *of Gems, to explicate some of them by intelligible Principles, and illustrate others by resembling*

bling things that may be really obſerv'd in nature or eaſily perform'd by Art. Which way of handling my Subject permitted me to hope, that, whether or no I ſhould be thought a lucky Conjecturer about the Subject I attempted, I ſhould, at leaſt in ſome meaſure, prove a Benefactor to what is perhaps preferable even to lucky Conjectures themſelves, the Natural and Experimental Hiſtory of ſuch Noble Subjects as GEMS.

ERRATA.

PAge 31. *line* 3. *read* moſt of Gems, *p.* 53. *l.* 7. *r.* yet I ſhall, *p.* 108. *l.* 20. *r.* ſented Steams, *p.*146. *l.* 18. *r.* in cloſe Veſſels, *p.* 168. *l.* 18. *r.* Obſervation, to which ſome, *p.* 164. *l.*8. *r.* in Air and Water, *p.* 172. *l.* 2. *r.* of kin to Metals, *p.* 178. *l.* 8. *r.* hæmorrhagy, *p.* 179. *l.* 17. *r.* moiſtened, *p.* 180. *l.* 8: *r.* Bolus's.

AN ESSAY ABOUT The ORIGINE and VIRTUES OF GEMS.

SECT. I.

THough it will not perchance prove very difficult to propoſe to you my Conjecture about the Cauſes of the *Vertues* of *Precious Stones*; yet I fear it will not be eaſy for me to acquaint you fully with the Grounds of it. For unleſs I ſhould tranſcribe for you my whole Diſcourſe of the *Origine* of *Minerals* in General (of which you know *Stones* make a part) I cannot well lay

before you all the Considerations, by which I have been induc'd to take up the Conjecture or *Hypothesis* I am about to propound: and consequently I cannot well comply with your curiosity about *Gems*, without either omitting several things which might much countenance the following Discourse, or proposing (without amply proving them,) some things, that I confess seem not cleer, nor some of them so much as probable, by their own Light. But since you will have it so; I will, rather than disobey you, present you in one Discourse several things concerning *Gems*, whereof some belong to others of my little Tracts about the *Origine* of *Minerals* from *Fluid* or at least *Soft Bodies*; thô some indeed were more directly written concerning Gems: notwithstanding that they were deliver'd not as an entire Tract about that subject, but as Corollaries that might be drawn from, and applications that might be made of, what had been in a more general way discours'd about the origination of Stones and other Minerals.

And

And therefore presuming that you will suppose with me in this Discourse some few particulars, that, I think, I have elsewhere made probable, and might perhaps do so from some of the *Phænomena* mentioned in this Writing it self, I would immediately address my self to the subject of it, if I did not think a previous Admonition very requisite.

For, I must at the very entrance of this Discourse desire you to take notice, that when I propose my Conjectures about the *Virtues* of *Gems*, I do not suppose the truth of all, or so much as the tenth part of those wonderful properties, that Men have been pleased to ascribe to them. For not only some of the Writers of Natural Magick, but men of note, who should be more cautious and sober, have delivered in their Writings many things concerning *Gems*, which are so unfit to be credited, and some of them perhaps so impossible to be true, that I hope the Believers of them will among the Votaries to Philosophy be as great rarities, as *Gems* themselves are among *Stones*. And those

that can admit such unlikely Fables, will be as much despis'd by the Judicious, as Jewels can be priz'd by the Rich.

For my part, I never saw any great feats perform'd by those hard and costly Stones, (as *Diamonds*, *Rubies*, *Saphires*,) that are wont to be worn in Rings. But yet because Physitians have for so many Ages thought fit to receive the fragments of pretious Stones into some of their most celebrated cordial Compositions; because also divers eminent Men of that profession, some of them famous Writers, and some *Virtuosi* of my own acquaintance, have by their Writings, or by word of Mouth, inform'd me of very considerable effects of some *Gems*, (especially *Christal*,) upon their own particular Observations: And lastly, because that (as I shall shew anon,) I find no impossibility that at least some costly and less hard, (though indeed more valuable) Gems, may have considerable operations upon humane Bodies, some few of which I have had opportunity to be convinc'd of, I will

not

not indiſcriminately reject all the Medicinal Virtues, that Tradition and the Writers about pretious Stones have aſcribed to thoſe Noble Minerals: Contenting my ſelf to declare in a word, that ſuſpecting moſt of them to be fabulous, my Conjectures aim only at giving one of the Cauſes of thoſe Virtues aſcrib'd to *Gems* which Experience warrants to be *real* and *true*.

Having thus explain'd in what ſenſe my Conjecture about the Virtues of pretious Stones is to be underſtood; it follows that I propoſe the Conjecture or *Hypotheſis* it ſelf; the ſubſtance of which may be compriz'd in theſe *Two* particulars: Firſt, That many of theſe Gems, and Medical Stones, either were once *fluid* Bodies, as the Tranſparent ones; or in part made up of ſuch ſubſtances as were once fluid: And ſecondly, That many of the real Virtues of ſuch Stones may be probably deriv'd from the *mixture* of *Metalline* and other Mineral ſubſtances, which (though unſuſpectedly,) are uſually incorporated with them: And the *Greatneſs* of the

Variety and Efficacy of those Virtues may be attributed to some happy Concurrent Circumstances of that Commixture. The *first* of these heads relates properly to the *Origine of Gems*. The *second*, partly to that, and partly to the *kinds* and *degrees* of their Virtues.

But that any Gems, especially the hardest sorts of them, should have a later Begining, then that of the Earth it self, will probably be thought to relish of a *Paradox*; and I doubt not, it will pass with many for a great one, that some of these hardest of solid Bodies should have been once fluid ones or Liquors: Wherefore I shall endeavour to Countenance this *Hypothesis* by the following Considerations.

1. And first the Diaphaneity of Diamonds, Rubies, Saphires, and many other Gems agrees very well with this Conjecture, and thereby seems to favour it. For 'tis not so likely, that Bodies that were never fluid should have that arrangement of their Constituent parts, that is requisite to transparency, as those that were once in a Liquid Form

Form, during which it was easie for the Beams of Light to make themselves passages every way, and dispose the solid Corpuscles after the manner requisite to the Constitution of a transparent Body. Therefore we see, that *Silver* in *Aqua Fortis*, or *Lead* in *Spirit of Vineager*, having by that solution had their particles reduc'd into a fluid Form, those particles, though before Opacous, are so dispos'd of as to make not only a Diaphanous solution, but, if one pleases, transparent Christals. And what Chymists usually try with those Metals, I have had the Curiosity to try with several Stones, which I may hereafter have occasion to name to you. But this Argument I bring rather to confirm than evince my Conjecture.

Secondly, The Origine assign'd to Gems may be also countenanc'd by the *External figuration* of divers of them. For we plainly see, that the Corpuscles of Nitre, Allom, Vitriol, and even Common Salt, being suffer'd to coagulate in the Liquors they swam in before, will convene into Christals of curious

and determinate shapes. And the like I have try'd in several metalline Bodies dissolv'd in several Menstruums. But unless a Concreting stone, or other like Body be either surrounded with, or in good part contiguous to a Fluid, 'tis not easie to conceive how it should acquire a Curious Angular and determinate shape. For Concrescent Bodies, as I may so speak, if they have not room enough in an Ambient Fluid for the most congruous ranging of their parts, cannot cast themselves into fine and Regular shapes, such as I shall presently show that divers Gems seems to affect; but the Matter they consist of must conform to the Figures of the Cavity that contains it, and which in this case has not so much the Nature of a Womb, as of a Mold. And so we see that Salt-Petre, and divers other Salts, if the Water, they were dissiolv'd in, be much too far boyl'd away before they are suffer'd to shoot, will, if the Liquor fill the Glass, sometimes coagulate into a Mass, fashion'd like the inside of the containing Vessel, or if a pretty quantity of Liquor

Liquor remains after the coagulation, that part of the nitrous Mass, that was reduc'd to be concreted next the Glass, will have the shape of the Internal surface of it, whatever that be; but those Christals that are contiguous to the remaining Liquor, having a Fluid Ambient to shoot in, will have those parts of their Bodies, that are contiguous to the Liquor, curiously form'd into such Prismatical shapes as are proper to Nitre.

To apply this now to Gems; That divers kinds of them have Geometrical and determinate shapes, though it be not vulgarly observ'd, because we are wont to see them when they are cut, if not also set in Rings and Jewels; yet I have often had the opportunity to take notice of it, by having had the curiosity to look upon many of them rough as Nature has produc'd them, and the good fortune to take divers of them out of their Wombs. For I remember, I have taken a good number of *Indian Granats* out of a Lump of heterogeneous Matter, whose distinct Cavities like so many Cells

Cells, contained stones, on some of whose surfaces you might see Triangles, Parallelograms, &c. And being once near the Rock, whence those Stones are chiefly fetch'd that are commonly call'd *Bristol-stones*, I remember, I rid thither and procur'd a Workman or two to dig me up a Number of them, divers of which I found to be curiously and determinately shap'd, much like some Christals of Nitre that I have taken pleasure to compare with them. And the like figuration I have also observ'd in divers *Cornish Diamonds*, and in a fair and large one, which one that knew not what it was, found growing with many lesser in *Ireland*, and presented me. And to let you see, that 'tis not only in these softer Gems that this curious figuration is to be met with, I shall add, that I found among many Stones, I had and took to be *Rubies* (and those the *Jewellers* will tell you are exceeding hard) a considerable number, whose shapes, though not the same with those of the *Cornish* and *Irish* Stones, were yet fine and Geometrical. And

the

the like I have obſerved even in thoſe hardeſt of Bodies, *Diamonds* themſelves; of which remembring that in my Collection of Minerals I had a pretty large one that was rough, I perceiv'd that the Surface of it conſiſteth of ſeveral Triangular Planes, which were not exactly flat, but had as it were ſmaller Triangles within them, that for the moſt part met at a point, and did ſeem to conſtitute, as it were, a very obtuſe ſolid Angle: Incourag'd by this, I examin'd ſeveral other rough Diamonds, and found the moſt of them to have Angular and determinate ſhapes, not unlike that newly mention'd. And having thereupon conſulted an expert *Jeweller*, that was alſo a Traveller, though he could not name to me the ſhapes of the un-cut Diamonds, he had met with; yet he told me, he generally found them to be ſhap'd like that I ſhew'd him; inſomuch that ſuch a ſhape was a mark, by which he uſually judg'd a Stone to be a right Diamond, if he had not the opportunity to examine it by the hardneſs.

And

And this I shall add in favour of the Comparison, I lately intimated betwixt the coagulation of *Petre* and that of *Gems*, that having once made an odd Menstruum, wherein I was able to dissolve some pretious stones, there shot in the liquor, Christals pretty large, and so transparent and well shap'd, that they might well have pass'd for Christals of Nitre; and yet, if I much misremember not, they were insipid. And I have divers times taken notice in such stones, as the Bristol Diamonds, That though that part, which may be look'd upon as the upper part of the stone, were curiously shap'd, having six smooth sides, which at the top were as it were cut off sloping so as to make six triangles, that terminated like those of a *Pyramid* in a *Vertex*; yet that which may be look'd upon as the root or lower part of the stone, was much less transparent (if not opacous) and devoid of any regular figuration; of which the reason seems to be, that this being the part whereby the stone adher'd to its womb, it was sully'd by the

the muddineſs of it, and reduc'd to conform it ſelf to whatever ſhape the contiguous part of the Cavity chanc'd to be of; whereasthe upper part of the ſtone was not only form'd of the clearer part of the Lapideſcent Juice before the wateriſh vehicle was exhal'd, but had room and opportunity to ſhoot into the curious figure belonging to its Nature. And this is much more conſpicuous, where many of theſe Chriſtals grow as it were in Cluſters out of one Mineral Cake or Lump; as I have ſeen not only in thoſe ſoft but yet tranſparent Concretions, which ſome of the later Mineraliſts (for the ancient ſeem ſcarce to have known them) call *fluores*, and particularly in a very fine mineral lump, that I had once the honour to have ſhew'd me by a great Prince, and no leſs great a Virtuoſo, to whom it was then newly preſented. For this maſs conſiſted of two flat Parallel Cakes, that ſeem'd compos'd of a dirty kind of Criſtalline ſubſtance, and out of each Cake there grew towards the other a great Number of ſtones, ſome of which by their

cohæ-

cohæſion kept the two cakes together, and moſt of theſe ſtones, having each of them a little void ſpace about it, wherein it had room to ſhoot regularly, were Geometrically ſhap'd, and, which look'd very prettily, were colour'd like a (German) *Amethyſt*. And I have my ſelf a pretty large ſtone, taken up here in *England* by a Gentleman of my Acquaintance, which conſiſts (as it were) of four parts: The lowermoſt is a thin and broad flake of coarſe ſtone, only adorn'd here and there with very minute gliſtering particles, as if they were, (as probably they may be) of a Metalline Nature; over this is ſpread another thin white, but opacous, bed, which is ſo inclos'd between the firſt nam'd bed, and the two others, that without defacing the ſtone I cannot well examine it: The third conſiſts of a congeries of minute Criſtals exceedingly thick ſet, which therefore look whitiſh, having little or no tincture of their own; and this part no more then either of the former, is not much thicker than a Barly Corn. The fourth and uppermoſt

moſt part, which yet ſeems in great part to be the ſame Chriſtals, which as they grow higher and ſpread, acquire a deeper colour, is made up of a great Number of *Amethyſts*, ſome paler, and ſome highly tincted, which are of very differing figures, and bigneſſes, according (as one may gheſs) as they had conveniency to ſhoot; *theſe* at one end of the ſtone lying in a flat bed (as it were) and ſcarce exceeding a Barly Corn in length; whereas *thoſe* at the other end ſhoot up to a good height into figur'd Criſtals, ſome of them as big as the top of my little finger, and thoſe are the moſt deeply colour'd, being alſo of a good hardneſs, ſince I found that they would eaſily grave lines upon Glaſs.

I remember alſo, that going to viſit a famous Quarry, that was not very far from a Spring which had ſomewhat of a petreſcent faculty in it, I caus'd divers ſolid pieces of rough and opacous ſtones to be broken, out of hope I had to find in them ſome finer juice coagulated into ſome finer ſubſtances; and accor-

accordingly I found, that in divers places, the solid and massy stone had cavities in it, within which, all about the sides, there grew Concretions, which by being transparent like Christal, and very curiously shap'd, seem'd to have been some finer Lapidescent juice, that by a kind of percolation through the substance, that grosser stone was made of, had at length arriv'd at those Cavities, and upon the evaporation of the superfluous and aqueous parts, or by their being soak'd up by the neighbouring stone, had opportunity to shoot into these fine Christals, which were so numerous as quite to overlay the sides of the Cavities, as I can show you in some large Clusters of them that I brought from thence. And inquiring of an ancient Digger, whether he had not sometimes met with greater quantity of them? he told me, that he had, and presented me a great Lump or mass made up of a Numerous Congeries of soft Christals, (but nothing so colourless as these other newly mentioned) sticking to one another,

another, but not any of them to any part of the Rock: So that they seem'd to have been hastily coagulated in some cleft or Cavity, as it were in a Mould, where meeting & mingling before Concretionwith some loose particles of Clay, the mass may thereby be discolourd.

Our Argument drawn from the figuration of transparent Stones may be much strengthened by the coalition I have sometimes observed, of two or more of such Stones, and the congruity in the shape of some of them to the figures of those parts of the others, that were contiguous to them and seem'd to have been form'd after them. But though this *Phenomenon* be considerable to the scope of my Discourse, yet perceiving that I shall have occasion to insist on it hereafter, I shall not do it now.

Thirdly, Nor is it only the external figuration of these Gems, but the internal Texture that favours our Hypothesis; some of them seeming much to imitate in their Coagulation several of those substances, which I have observ'd to

have once been fluid. That common Salt may be made up of small saline Particles, that by a Convenient Juxta-Position may be associated into great Lumps, divers of which are cubically shap'd, is an observation easie enough to be made. And that such Coalitions of particles may constitute solid and considerably hard Bodyes, I have try'd by breaking some of the larger Cubes of Sal Gem, and the Lumps of the Isle of *Mayo-Salt*, whereof the first is *fossile*, the other *marine*, and both *Natural*. I have likewise found by Tryal, that, though Silver dissolv'd in Aqua-fortis appears usually to shoot, if it be taken notice of, into flat and exceeding thin flakes; yet 'tis very possible so to order the coagulation, that many of these thin Plates shall in their Convention have their flat sides so plac'd over one another, as to make up pretty large and thick Christals, whose very outsides will be finely shap'd as being some peculiar kind of Vitriol. Nor are these the onely fluid Bodies, which I have reduc'd to coagulate into Conventions, of such a flaky

flaky Texture; wherefore I began to ſuſpect that divers tranſparent Minerals may have the like; and in ſome Diaphanous kinds of Talk, whoſe outſides were Mathematically figur'd, I found Encouragement to try, whether ev'n ſome Gems themſelves, notwithſtanding their hardneſs, might not have ſuch an Internal figuration. Nor was I deterr'd by conſidering, that 'tis taken for granted, that Gems are of an uniform Texture, and that there muſt be a ſtrange thinneſs in the Plates that make up tranſparent ſtones, ſince no ſuch thing has been noted by the moſt curious Eye, but men have taken it for granted, that the Texture of all Gems is Uniform, without any grain or fibres, no more than there is in Gold. But as to the thinneſs of the Plates, I remember, I have ſeveral times taken pleaſure to hold a peice of good *Muſcovia-glaſs* againſt the Light, when it was of ſuch a thinneſs, that the ſpectators, though provok'd to look with curious Eyes, could ſcarce ſee the Plate it ſelf, and would by no means be brought to

think that it was poſſible to ſplit it, till I did actually do it; and ſometimes I then ſubdivided it beyond ev'n my own Expectation. But to examine this Conjecture, I took ſome ſtones that had Geometrical figures on part of their Surfaces, and which I had other grounds to think to have been once fluid ſubſtances, and having diligently ſurveyed ſome of them, which ſeem'd likelieſt to give me ſatisfaction, I manifeſtly enough perceiv'd, not only with my aſſiſted, but with my naked Eyes, divers parallel Commiſſures, which ſeem'd plainly to be made by the contiguous Edges of little thin Plates of ſtone, that appear'd to lye one over another, almoſt like the Leaves of a Book that is a little open'd.

I remember that holding a large and rough Grizolette (as Artificers call hard Gems, of a blewiſh colour, brought them from *East India*) againſt the Light and curiouſly obſerving it, I have ſometimes plainly diſcern'd a grain, as they call it, in the Stone, and was anſwered by a skilful Artiſt that us'd to make Seals

Seals of them, that ſuch Stones would uſually ſplit according to the *Ductus* of their Grain. I will not urge, that in ſome other Precious Stones, that were cut and Poliſh'd, as particularly the Hyacinth, and ev'n the Saphire, by converting them ſeveral wayes to the Light, I have been able to obſerve, as it were, Commiſſures, which were ſo fine, as not to hinder, or call in Queſtion the Intireneſs of the Stone, for the Lapidaries purpoſe. This I ſay I forbear inſiſting on, becauſe the *Phænomenon* is far leſs conſiderable than what I have ſeveral times obſerv'd in New Engliſh *Granats*, wherein, eſpecially when they are broken, the Edges and Commiſſures of the thin Plates or Flakes, whereof they conſiſted, were very eaſily diſcernable. And to try whether this obſervation would hold even in the hardeſt Stones, I had recourſe to a pretty big Diamond unwrought, which being plac'd in a Microſcope, ſhew'd me the Commiſſures of the Flakes I look'd for, whoſe Edges were not ſo exactly diſpos'd into a plain, but that ſome of them

were very ſenſibly extant like little Ridges, but broad at the Top above the level of the reſt. And theſe Parallel flakes together with their Commiſſures, I could in a ſomewhat large Diamond plainly enough diſcern even with my unaſſiſted Eyes. And for further ſatisfaction, I went to a couple of Perſons, whereof the one was an Eminent Jeweller, and the other an Artificer, whoſe Trade was to cut and poliſh Diamonds, and they both aſſur'd me upon their repeated and conſtant Experience, and as a known thing in their Art, that 'twas almoſt Impoſſible, (though not to break, yet) to *ſplit* Diamonds, or cleave them ſmoothly croſs the Grain, (if I may ſo ſpeak,) but not very difficult to do it at one ſtroke with a Steeled Tool, when once they had found out from what part of the Stone, and towards what part the ſplitting Inſtrument was to be impell'd: By which 'tis evident that Diamonds themſelves have a grain, or a flaky Contexture not unlike the *fiſſility*, as the Schools call it, in Wood; which you will eaſily grant

to

to consist of assimilated water or Juices; which having been once fluid Bodies, were fit to have their Particles so rang'd or dispos'd, as to constitute a Body far more easie to be cleft according to the *Ductus* of the Fibres (or Planes) than otherwise. And I remember that having, as I thought, observ'd in a rough Diamond, which I purposely examin'd, that the Flakes whose Edges were terminated in one plain, were far enough from being parallel to those whose Edges compos'd another plain, (I speak of Physical planes of the same Stone,) I imagin'd that if this Diamond were to be cleft, it would not be smoothly split into two peices, because the Commissures did probably make Angles in the Body of the Stone; and accordingly I learned of the ancientest of these Diamond Cutters, that sometimes he met with Stones, that eluded all his skill, and would by no means be split like others into two parts, but, before they were cleft quite through, would break in pieces; which was a defect in the Stone he could not certainly foresee,

but was fain to learn from the unwelcome Event.

Fourthly, It seems not unprobable, that the Colours of *divers* Gems (for I do not say of *all*) are *adventitious*, and were imparted to them, either by some colour'd Mineral Juice, or some tinging Mineral exhalation, whil'st the Gem or Medical Stone was either in *Solutis Principiis*, or of a Texture open enough to be penetrable by Mineral Fumes. Which Arguments considerableness makes me hold it unfit to be lightly touched in this place; though I cannot discourse any thing fully of it in few words, because it not only *suggests* divers observations and other particulars, but *requires* also the mention of some of the chief of them; which therefore I shall now subjoin.

1. And the first shall be, That many Gems, not to say almost all of them, have been observ'd to be depriv'd of their Colour, if having fallen, or been put into the Fire they have layn too long there: Insomuch that I have found it affirm'd upon the Testimony

of

of the Learned and Experienced *Boetius de Boot*, that all Gems will looſe their colour in the Fire except *Bohemian* Granats. How far this may be true I have not had opportunity thoroughly to examine. But I well remember that having purpoſely expos'd divers Gems to the fire, though that were but moderate, and had a Crucible interpos'd between it and them, ſome of them ſeem'd to have their Tincture much impair'd, and others quite deſtroy'd. But I muſt be ſo free as to admoniſh you, that if theſe Tryals be not warily made, they may eaſily impoſe upon us; eſpecially if we do not conſider the nature and cauſe of Whiteneſs. For any Diaphanous Body, as far as I have yet obſerv'd, being divided into a multitude of very minute parts, and conſequently acquiring a multitude of diſtinct ſuperficies's, which do briskly reflect the Light every way outwards, will appear to have a white colour that will be more or leſs vivid as the particles are more or leſs numerous, minute, and otherwiſe fitted to ſcatter the inci-

incident Beams of Light; as you may ſee by reducing to powder fine *Venice*-Glaſs, which will be white; and ev'n red Inck, if ſo ſhaken or beaten as to be brought to a froth, conſiſting of many minute Bubbles, will ſeem to have put on a whiteneſs. So that if by too haſty an Ignition, or too haſty a cooling of the fir'd Gems, they come to be flaw'd with innumerable little Cracks, they may be thought to be made white by having their Tincture driven away, when their whiteneſs really proceeds from the multitude of thoſe little flaws which are ſingly unperceiv'd; and the rather, becauſe the Body may ſtill retain its former ſhape or ſeeming intireneſs. To illuſtrate which, I have ſometimes taken pleaſure to heat a piece of Chriſtal red hot in a Crucible and then quench it in Cold Water: For ev'n when the parts did not fly or fall aſunder, but the Body retain'd its former ſhape, the multitude of little Cracks that were by this operation produc'd in it, made it quite looſe its tranſparency and appear a White Body. In making which experiment,

periment, the multitude of produc'd flaws may be pretty well diſcover'd to the incredulous, if, as I have ſometimes done, the ignited Chryſtal be warily and dextrouſly quench'd not in Water but in a very deep ſolution of Cochaneel made with Spirit of Wine, in which operation, if it be well performed, (but not otherwiſe,) enough of the red Particles of the ſolution will get into the cracks of the Chryſtal, to give it a Pleaſing Colour.

About Tincture of Coral.

The other tryals that I have made about the reducing of Whiteneſs or paleneſs in bodies, either tranſparent, or even Semi-Diaphanous only, belonging to an other paper, I ſhall here forbear to mention them, having already ſaid enough for my preſent purpoſe, which is not ſo much to affirm poſitively, that no Proof at all can be drawn from the operation of fire upon the Colour of Gems, as to make you cautious, what Proofs drawn from thence you admit.

2. Wherefore declining to ſay any thing

thing more about the *firſt*, I ſhall now proceed to the *next* Circumſtance, that belongs to our Argument, (which you may think to be more Conſiderable then the former) namely that the Colours of ſeveral Gems, when they are not *deſtroy'd* by fire, will be *alter'd* thereby; which being a thing that happens to divers foſſile Pigments (of which ſome I imploy to tinge Glaſs,) and other Bodies confeſſedly Mineral, argues a Commixture of Mineral ſubſtances in thoſe Stones whoſe Colour receives ſome of the Alterations I ſpeak of; which laſt words I add, becauſe I would not impoſe upon you by concealing, that there may be a change of Colour produc'd by the fire without any alteration of the tinging parts as ſuch. For by flawing the heated Gem in very many parts, a degree of whiteneſs or paleneſs emerging thereupon may ſomewhat change the former Colour. But this Alteration being but a kind of Dilution, is not that which I here mean. For I remember I have taken *Indian* Granats, and having in a Cru-

Crucible expos'd them to the fire, I found they had exchang'd their reddish Colour for a Dark and Dirty one, like that of Iron that has been long kept in the Air. And having taken some pieces of Agate prettily enough adorn'd with waves of differing Colours, and kept them a competent time (for they should not be kept too long) in the fire, I found, as I conjectur'd, that the greatest part of the Agate seem'd to be depriv'd of its Tincture, being reduc'd to a pleasant Whiteness: But in some places where there were stains of a differing kind from the rest, and where there ran little Veins, that I ghess to be of a Metalline Nature, there, I say, the Colour was not destroy'd, but chang'd, and the Veins of Pigment thus colour'd acquir'd a deep redness, which they will retain, if let alone; though I was induc'd to think by some Tryals made on other pieces of *Indian* Agate, that even these Metalline Tinctures were not so fix'd but that a lastinger fire would drive them away, and leave the stones purely white.

Such

Such a change of Colours as I lately mention'd in the Veins of Agate, is likewiſe found in thoſe of ſome other Stones, as alſo in ſome Pebbles, amongſt divers of which, that loſt only their Tranſparency by Ignition and Extinction in Water, one or two acquir'd ſo much deeper a Colour then it had before, that I thought it remarkable.

3. Another Circumſtance that ſeems to favour our Conjecture may be this, That it has been obſerved not unfrequently, that near many of the places, where colour'd Gems are found, ſome Mines or Veins of Metals are to be met with. And I think it not unlikely, that if ſearch were skilfully made, many more Diſcoveries would be made of Veins either of Metalline Oar or ſome other Mineral, Liquid or Concreted, whence, by way of Juices or Fumes, the Gems may be preſum'd to have receiv'd Tinctures. But uſually where pretious Stones are found, Mens Induſtry and Curioſity is too much confin'd to thoſe rich Minerals, and does not make them ſolicitous to look after inferiour

ſeriour Ones. Beſides, that in *East-India*, whoſe Countreys are beſt for the moſt Gems, they are wonderfully unskillful at digging Mines; as I have gather'd from the Anſwers of ſome, who purpoſely went to viſit the Diamond Mines, as they call them. To this may be alſo referr'd, that Gems are ſeveral times found in the Metalline Veins themſelves, or very near them: As I can ſhew you divers Amethyſts that an ingenious Gentleman of my Acquaintance took himſelf out of a piece of Ground abounding with the Ores of Iron and Tin, the latter of which was there plentifully dug up. And in thoſe colder Countryes, ſuch as *Germany* and *England*, where hard Gems are more unfrequent, thoſe ſoft ones that Mineraliſts call *Fluores*, are often to be found in or near Metalline Veins, ſo finely tincted by Mineral Juices, that, were it not for their ſoftneſs, they might paſs at leaſt among moſt Men, for Emeraulds, Rubies, Saphires, *&c.* as I have been inform'd, not only by ſome Mineral Writers of good credit, but alſo by

by eye witnesses, and partly by my own Observation.

4. The fourth Circumstance which may be alleag'd to the same purpose with the three foregoing, is, That it seemes possible, from some Gems by Menstruums to obtain Tinctures that seem rather Extractions, than Dissolutions strictly so call'd: I will not urge the Chymical Processes that may be met with in some Authors to this Effect, because some Circumstances in the things and in the Writers, made me so far suspect those I could try, (and those that requir'd undiscover'd Menstruums, as they may be true, so, for ought I know, they may not,) as to keep me from medling with them. But I remember, I *once* made a Menstruum, (I say *once*, because its preparation is so subject to casualty, that I have often fail'd in it) which being pour'd upon well colour'd *Granats*, not only not calcin'd, but intire, was in no long time beautifi'd with a high and lovely Tincture, which was admir'd by very skilful Persons, to whom I shew'd it, because the

the Menſtruum was not more corroſive than White-Wine; and which yet I therefore took to be a genuin Tincture, partly becauſe it was drawn in the Cold, partly becauſe the Liquor would not tinge it ſelf by ſtanding, if no Body were put in it, and partly becauſe it drew a Tincture from Antimony of a very differing colour from this we ſpeak of. Nor are Granats the only Gems, which I have made the Liquor work on, in the Cold.

5. To theſe Four Circumſtances I ſhall add this Fifth; That ſome Gems, which Jewellers affirm without ſcruple to be Rubies, Saphires, *&c.* either are colourleſs, or have other colours than thoſe that are wont to belong to them. That famous Gold-Smith, *Benvenuto Cellini*, in his little *Italian* Tract of his own Profeſſion, admoniſhes his Reader, that there are one kind of Rubies, that are Naturally white, (and not made ſo by Art) which he proves by the degrees of hardneſs peculiar to Rubies. And the ſame Author elſewhere tells us of *Berills*, *Topazes*, and *Amethyſts*, that are white. And it

Page 10.

ſeems, by what he ſays not far from that place, that the *Italian* Jewellers did not look upon the Tinctures of Gems as any thing near ſo Eſſential to them, as they are commonly reputed, ſince they reckon *Topazes* and *Saphires*, whereof one is Blew and the other Yellow, but both extreamly hard in compariſon of other Gems than *Diamonds* (and perhaps *Rubies*,) to be of the ſame ſpecies. The Degree of hardneſs of *Rubies* and *Saphires* is oftentimes ſo equal, that I knew an expert *Engliſh* Jeweller, who for that only Reaſon (for he knew not whence the difference of *Colours* might proceed) took *Rubies* and *Saphires* to be of the ſame kind of Stone.

And that Gems, referr'd by Lapidaries to the ſame kind, may be very differingly ting'd, is a truth, whereof I have ſeen notable Inſtances in *Diamonds* themſelves; which I therefore prefer to other Inſtances, becauſe the extream hardneſs of Diamonds is ſuch as keeps Jewellers from miſtaking any other Stone for a true Diamond, if they are permitted to put them on their rapidly

pidly mov'd Wheels employ'd to cut them. Now of true Diamonds I have ſeen ſome, that were Yellowiſh, others that were more Yellow, and among the reſt, one that was ſo perfectly Yellow, that I at firſt took it for a fair Topaz, though it were a Diamond valued at near three pound weight of Gold: I have alſo ſeen Diamonds and thoſe rough, as they came directly out of the *Indies*, and were ſoon after bought by Traders in Diamonds for ſuch, which were either Blewiſh or Greeniſh. And I particularly contemplated one Stone, which, if its ſhape and other things had not convinc'd me of the contrary, was ſo Green, that I ſhould have taken it for an Emerald.

I remember I had once occaſion to buy a conſiderable number of ſmall *Rubies*, divers of which were very curiouſly ſhap'd, and coming to look upon the whole parcel more leaſurely than my haſt would permit me when I bought it, I found in a great number of other Stones one, and but one, that was devoid of any Colour; but in other

respects was so like the rest, as invited me to conclude that it would have encreas'd their number, but that it was coagulated and harden'd before the Mineral Pigment had ting'd it of the same Colour with the rest. In which gues I was confirm'd, when, having met with a Gentleman, who had been in the chief Places of the *East Indies*, where Rubies are found, and particularly at the River of *Siam*, or *Pegu*, near which he liv'd a good while, and where he frequently saw Rubies taken out of the bottom of the Water, and sometimes took them out himself; I learn'd of him by enquiry, that he had there seen several Stones, each of which was partly a Ruby and partly colourless: And sometimes in the same Stone there would be two portions of one sort, and the third, though lying betwixt them, of another: Which has frequently obliged the Jewellers considerably to lessen the Bulk of such Stones by cutting off the untincted part. And, if my memory do not much deceive me, I saw in a great and curious

Princes

Princes Cabinet, among other rarities, a Ring, in which was ſet a Stone of a moderate bigneſs, whereof onely one half, or thereabouts, was well tincted, the other being colourleſs. In Gems that are leſs precious, and not ſo tranſparent, eſpecially in Agats and in Opacous Gems, I could eaſily give a multitude of Inſtances of the differingly tincted parts of the ſame entire Stone. And I uſually wear in a Ring a ſmall Sardonix that was once a great Princes, wherein there are three Portions one within another, the uppermoſt, Black, the middlemoſt of a kind of Cheſnut colour, the other of a Blew, almoſt like a Turquois, each of which portions is exactly of a fine Oval figure, and each of the two uttermoſt is thoroughout of a very uniform Breadth as well as colour, and exactly parallel to the other. But 'twould not be here ſo proper as 'twill be hereafter, to multiply Inſtances of Opacous Gems: Wherefore (having mentioned only the Sardonix, becauſe 'tis not alwaies Opacous,) I ſhall add concerning Tranſparent ones, That

Jewellers reckon among Saphires not only that ſort of Azure Gems which uſually paſs for ſuch, but alſo another ſort of Stones, becauſe of their Saphirine degree of hardneſs; though for their want of Tincture they call them white (Saphires.)

6. The Sixth and laſt Circumſtance belonging to the foregoing Argument or Conſideration is this, That ſometimes one may find Gems that are partly tincted and partly not: As if the tingeing Pigment mixing with one part of the matter whereof the Stone conſiſted whilſt it was Liquid or ſoft, were not copious enough to diffuſe it ſelf to the Whole, nor to give an equally intenſe Colour to all that portion that it tinges. 'Tis true that in ſome caſes the Diffuſion may be ſtopp'd by the Petreſcent Juices coagulating firſt in another part than that with which the Tincture was mix'd. And perhaps, in ſome other Caſes, the different Colours may have belonged to differing portions of matter, coagulating upon or againſt each other, at differing times, yet ſo as to

ſeem

ſeem one intire Stone, as I may have hereafter occaſion to declare. Yet ſince, which ſoever of theſe explications be admitted, it will, if it belong not to this place, at leaſt confirm our main *Hypotheſis* (of the Origine of Gems from fluid or ſoft materials:) I ſhall return to what I was ſaying about Gems, partly tincted and partly colourleſs. And having onely intimated upon the by, that in ſome hard Semidiaphanous Stones, *European* and *Eaſt Indian*, I have obſerved a very unequal and irregular diffuſion of the Tincture: I ſhall add to the things, that may be gather'd in favour of the propos'd Conjecture from ſome of the things before (as alſo ſince) related, theſe two Particulars.

The one, That I have (as I think I elſewhere mentioned) ſeen in *Italy*, among Rarities, a large piece of Chriſtal about the bigneſs of my two fiſts, whereof the Pyramidal part was of a Tranſparent Green, the *Vertex* being richly ting'd like an Emerald; but the further the colour ſpred from the *Vertex*, the fainter and paler it grew; ſo

that, before it came neer the Base, it was quite spent, if I may so speak, leaving the bigger part of the Stone transparent, but colourless, like ordinary Christal. And by this perhaps we may explain an Expression of *Josephus Acosta*, where he sayes, that *Emeralds* grow in Stones like unto Christals, and that he had seen them in the same Stone fashioned like a Vein; *And they seem*, adds he, *by little and little to thicken and refine*. And in the same place this Learned Author has a memorable observation, that may confirm both what I have just now related, and what we mentioned a little above, about *colourless Gems: I have seen*, sayes he, *some that were half White and half Green; others all White, and some Green and very perfect*. And this is the first Particular I was to mention.

The *Other* is afforded me by the way I have us'd and elsewhere describ'd, of giving to pieces of Rock Christal passably good Tinctures by Mineral Fumes. And supposing the thus colour'd pieces to be as intire Stones as the beholders have

have generally believed them, the inſtance will be pertinent to our purpoſe inſpite of an objection. For though the Colours thus given are not wont to pervade them very deep, and have their penetration aſſiſted by no faint degree of heat; yet 'tis to be conſider'd on the other ſide, that theſe pieces of Chryſtal had attain'd their full hardneſs, and after their colouration, are cut and poliſh'd like other Chryſtals: Whereas the Gems that our Conjecture means, are ſuppos'd to have been ting'd under ground when they were yet fluid, or at leaſt ſoft. That there are ſometimes generated in the Bowels of the Earth Mineral Exhalations capable of applying themſelves to the Stones they meet with there, I have in another Diſcourſe ſufficiently declar'd. That alſo ſome hard and ſtony ſubſtances have been actually tinged with ſuch Mineral Steams, I ſhall, in the ſubſequent part of this Diſcourſe, have occaſion to take notice. And I remember too, that even in ſo hard a Gem as a Saphire,

Of Subterraneal Fires, &c.

Saphire, I have observ'd the efficacy of these Subterraneal Fumes; having divers times seen one of those Stones, wherein a fine Seal was cut, which continu'd so oddly ting'd notwithstanding what had been taken off to reduce it to an exquisite shape, that having inquir'd of a skilful Person of my acquaintance by whom it had been Ingraven, he both assur'd me that he had found it of the full hardness of a Saphire, and confess'd to me, that the Mineral Fumes had so oddly ting'd it, that in his opinion it might, by the Looks, pass (rather) for a *Chalcedonian*.

And now, Sir, I fear I may need your pardon for having been so prolix in Discoursing of one of the Particulars belonging to our Argument; to excuse which, I have no other Apology to make, but that I hope what hath been deliver'd, will scarce seem impertinent, and that I might easily have made it more tedious, if, to decline doing so, I had not purposely made some omissions.

Having then said thus much about our

our *fourth* Conſideration, I proceed now to add in the *fifth* place, on the behalf of the Hypotheſis hitherto favour'd, an Argument which I preſume you will not think inconſiderable; Namely, that Solid Gems may include Heterogeneous matter in them. Several Inſtances of this ſort in opacous Stones, I elſewhere recite upon my own Obſervation; but in tranſparent ones they are very great Rarities; and therefore it will not, I preſume, be thought ſtrange, if I mention but a few.

Firſt then on this occaſion I remember, that a very ingenious and qualify'd Lady, who had accompany'd her Huſband in an Embaſſy to a great Monarch, aſſur'd me, that ſhe brought thence among ſeveral Rich Preſents and other Rarities, (ſome whereof ſhe ſhew'd me,) a piece of Chriſtal, in the midd'ſt of which there was a drop of Water, which by its motion might be very eaſily obſerv'd, eſpecially when the Chryſtal was made to change its poſture. And, if my memory deceive me not, I have

I have in ſome pieces of Rock-Chryſtal taken notice of things that ſeem to argue, that ſomewhat or other was intercepted within the Body of the Stone.

A curious perſon, that traded much and was very skilful in *Indian*-Gems, particularly *Griſolets*, which he got from the *Indies*, and whereof he ſhew'd me the largeſt I have yet ſeen, being ask'd by me, whether he had ever found in them any Heterogeneous ſubſtance, which ſomething, I had obſerv'd, made me ſuſpect that ſome of them might harbour notwithſtanding their hardneſs; he averr'd to me, that among divers rough ones, that were brought from the *Indies*, he had with wonder ſeen one that was about the bigneſs of a Filberd, in the Solid ſubſtance whereof there was a Cavity with a certain Liquor in it; which by changing the poſture of the Stone might be made to move to and fro in the Cavity: And when the drop was ſettled, it was of the bigneſs of a round Pearl that he ſhew'd me, which wanted ſomewhat of a moderate

derate ſize for a Neck-lace. And when he had anſwer'd the Queſtions I propos'd him to clear my Doubts, he added, that this Rarity made the Stone, which was otherwiſe of a ſmall Value, priz'd at an hundred Pound. And I have my ſelf ſeen a monſtrous Gem, if I may ſo call it, and little leſs a Rarity then the former, that an acquaintance of mine had bought, (as I afterwards learnt,) from this Relatour; whoſe Narrative about the *Griſolet*, I think the more Credible, becauſe, that having had the curioſity to break a Stone, that was brought as a Rarity from the *East-Indies*, where Gems are often harbour'd in ſuch Stones, I found in the Solid ſubſtance of it (which was ſo hard as to ſtrike fire like a Flint, and in its little flakes was at leaſt Semediaphanous) a Cavity wherein were coagulated very minute but poliſh'd and Chryſtalline Stones, which ſeem'd to have their points inwards, which argued, that there had been ſome Liquor, in which theſe gliſtering particles had ſhot, though in proceſs of time the remaining

and

and incoagulable part of it may have been imbibed by the Ambient Matter if not have eſcap'd thorough it, by Virtue of ſome peculiar congruity of it with the Pores of the Stone. Which need not be thought impoſſible, ſince experience has aſſured us, that ſome ſolid Stones and even Gems may be (though ſlowly) penetrated or have their Texture altered by common Water. Nor are theſe the only Heterogeneous ſubſtances I found included in this Stone.

And if, as Amber is reckon'd among Gems, and is ſometimes of a greater hardneſs than one would expect, ſo I could reckon it among true Stones, 'twere eaſie for me to borrow thence a great confirmation of what I have been ſaying; and how ever it will afford me an Illuſtration of it. For, not to mention many things, of what I elſewhere recite my ſelf to have ſeen in Amber, I have now by me a fine piece of clear and Solid Amber, (preſented me by a Perſon no leſs extraordinary than it) in which is included a large intire fly, in ſhape and ſize much like a Graſs-hop-

per,

per, but variously and curiously colour'd, with his Wings displayed.

To these Observations I shall add only this, That I have had my self, and shewn to others, one of that sort of pale *Amethysts*, that some call white Amethysts; which had been cut to be set in a Ring, or turn'd into a Seal, and was like that sort of Gems so hard, that I could readily cut Glass with it; and yet in the Body of this Stone there appear'd to be a considerable number of things that look'd just as if they had been hairs, some of them lying parallel, and others inclining to one another; and having contemplated them as well by Day-light as Candle-light, and in divers positions in reference to the Light and the Eye, some of them seem'd at times to be of a lovely reddish Colour, but reflecting the Light, as if they were well fill'd either with Air or Water: But for the most part they did, as I was saying, seem to be hairs of a Brownish Colour, which made the Stone not a little wonder'd at even by curious and skilful Men. I leave you to judge,

Whether

Whether 'twill be fit here to add, that I have ſometimes ſuſpected, that even in *Diamonds* themſelves there may poſſibly be found intercepted, or mingled with a pure Lapideſcent ſubſtance, ſome Particles of Heterogeneous Matter. And *that* in this ſuſpition I was ſomewhat confirm'd, *as* by the odd Clouds I had obſerv'd in an extraordinary Diamond, and by ſome Hydroſtatical, and other Obſervations I made about thoſe Stones; (ſome of which I found heavier than either Chryſtal or white Marble,) *ſo* by my having purpoſely demanded of an ancient Cutter of Diamonds of great Practice and Experience, whether he obſerv'd not a ſenſible difference of weight among Diamonds of the ſame place: For to this he reply'd, that he had; eſpecially in thoſe that were cloudy or foul: Inſomuch that ſhewing me a Diamond that ſeem'd to me to be about the bigneſs of two ordinary peaſe or leſs; he affirmed that he ſometimes found in Diamonds of that bigneſs, about a Carrat (which is by common eſtimation four Grains) difference in point of weight.

The

Sixthly, The laſt Argument I ſhall imploy to ſhew, That the Matter of divers Gems may have once been fluid, may be taken from the Proofs you will meet with (in the following part of this Tract) of the Second Member of our Hypotheſis. For if it ſhall appear, that ſeveral even of the tranſparent Gems have metalline or other extraneous Mineral Bodies mingled with them, *per minima*, it will be very agreable to reaſon to ſuppoſe, that ſuch a mixture was made, when the mingled Bodies were in a fluid form; ſince, beſide that one may well ask, how elſe the Metalline Corpuſcles came to be convey'd into ſuch compact and hard Bodies as Gems, 'tis very eaſie to conceive, if our Hypotheſis be admitted, and very hard otherwiſe to apprehend, how among Bodies that differ *toto genere*, as Metals and Stones, there ſhould be made mixtures ſo exquiſite as many of theſe appear to be, partly by the Uniform Coloration of the Gem, and partly by the Diaphaneity retain'd notwithſtanding this diſperſion of Mineral

Pigments through the whole Maſs; and in many Inſtances alſo by the Curious Figuration that we have lately been diſcourſing of.

Poſt-ſcript. To all the foregoing Circumſtances, I can now add ſomething, that I met with, ſince I thought to conclude with the Laſt of them, and that tends highly to the Confirmation of our Hypotheſis. In a Tract that makes part of a ſmall Book freſhly Publiſh'd in *French*, principally to acquaint Men with the waies of eſtimating Gems according to the Rates of Modern Jewellers, the Anonymus, but Curious Author, takes occaſion, to give us, from the Mouth, as he affirms, of the Famous late Travellers he convers'd with in divers places, (and whoſe Relations are indeed the recenteſt I have ſeen in Print) an account of the Number, and Names of the places, where Diamonds and Rubies are found in the *Indies*, adding ſome Circumſtances and Particularities about the Qualities of the Soil in thoſe places that I have not elſewhere met with. This Author then ſpeaking of

of the first of those three Diamond-Mines, which he makes to be the only ones in the *East-Indies*, having told us that the Stones are there found some in the ground and some in the Rock, subjoyns, that those that are drawn from the Rock, or the neighbouring parts, have ordinarily a good Water; but for those which are drawn out of the Ground, their Water partakes of the Colour or Soil wherein they are found. So that if the Earth be clean and somewhat Sandy, the Diamonds will be of a good Water; but if it be fat or black, or of another colour, they will have some tincture of it. Nay he immediately annexes, that if there be some black or red Sand among the Earth, the Diamond will also have some grain of it. And elsewhere mentioning *the Second Mine* of *Diamonds*, which the Natives call Gems, he admonishes his Reader, that in this, as in the Mine of *Visapour*, (which is that formerly mention'd) the Stones partake of the Quality of the Soil where

Que's ilya quelque sable noir ou rouge parmi la terre, le Diamant aussi en aura quelqu' un Pag. 9.

they are found; so that if that be boggy or moist, the stone will incline to Blackness, and if it be reddish, 'twill have an Eye of that Colour. Elsewhere he tells us, that of late Years there were found in the Kingdom of *Golconda* store of Diamonds, which were brought to the *Nababe*, or first Minister of State, who forbad the making any further search after them, finding not one in the whole number to have a good Water, all of them being Black or Yellow. But by the way, whereas this Author affirms it as a clear Truth, that as Gold is the heaviest and most precious of Metals, so Diamonds are the hardest, and heaviest of all Stones, he must excuse me if I declare, that what he asserts agrees not with my experience, who having try'd the weight of an uncut Diamond Hydrostatically, have taken such a course to estimate its specifick Gravity, as I find not to have been yet taken by any other, and which you will easily grant to be more exact than any other of the known wayes can be.

Page 18. 19.

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The

The Argument that hath detain'd us all this while, compriſed ſo great a variety of Matter, and may, I hope, perform ſo great a part of my task in this Diſcourſe, that, though I ſhall not much apologize for having dwelt ſo long upon it, yet I ſhould think my ſelf obliged to make ſome amends for my paſt prolixity by being ſuccinct in the remaining part of this Treatiſe, and therefore, having left off with an intimated promiſe to ſhew more fully, that divers Gems contain Metalline or other Mineral ſubſtances in them, I ſhould immediately connect thoſe Arguments to what hath been lately ſaid, but that I think it altogether requiſite, to make way for what is to follow, by firſt taking notice of a main Objection, that may be urged againſt the Doctrine we have been propoſing.

This is taken from the Figuration of ſome Gems (and eſpecially the Priſmatical one of Chriſtal) and ſeems the more fit to be urg'd againſt us, becauſe we our ſelves have, in the Second of the above-recited Arguments, given ſeveral

veral Inſtances of it. For it ſeems ſcarce poſſible, that ſo curious a ſhape ſhould be ſo Uniformly produc'd in ſuch a multitude of Chriſtals, great and ſmall, unleſs there were ſome ſeminal and plaſtick power to faſhion the matter after ſo regular and Geometrical a manner.

But he that ſhall attentively conſider, what I elſewhere ſay concerning the Figuration of Salts and of Metalline and other Magiſteries diſſolv'd by, and concoagulated with Salts, may be very much aſſiſted to diſcover the Invalidity of this Objection. But yet, becauſe I confeſs 'tis very ſpecious, if not important, I am content here to conſider it a little more particularly.

To this plauſible Objection then, I have two or three things to anſwer; Firſt, That there is no abſurdity to conceive, that if there be a Seminal and plaſtick power in Mineral Bodies, it may be harboured in Liquid Principles, as well as otherwhere. For we ſee that the Seed of Animals, which oftentimes,

as

as in Elephants, Rhinocerots, &c. produces hard and ſolid Bones, Teeth, and Horns, is at firſt but a Liquid ſubſtance; and the Formative power in ſome Trees and their Fruits does convert the Alimental Juice into Woods, Shells, and other Bodies very Solid and ponderous.

But Secondly, I elſewhere ſhew, that ev'n in the Figures of Allom, Vitriol, and other Salts, that are ſo curiouſly and Geometrically ſhap'd, there is no neceſſity to fly to a diſtinct Architectonick principle; but that thoſe Bodies themſelves may receive their ſhapes from the Coalition of ſuch ſingly inviſible Corpuſcles, as by the Motion of the Fluid, wherein they did ſwim, and by divers aſſiſtant Circumſtances, are determin'd to ſtick together rather in that manner than in another. That this may be apply'd alſo to other Bodies, I ſhall need to ſhew in this place by no other Inſtance than that of the Salt, that (in this or ſome other paper) I formerly told you I made

See the Origine of Forms and Qualities *now publiſh'd by the Author.*

of common Salt, only by the help of Oyl of Sulphur or of Vitriol and Water. For *though* it be manifefestly a factitious Body compounded of Salt and Sulphur, and such a Body that therein the Sea-Salt, whereof 'twas chiefly made, has had its own Nature destroy'd; *yet* by reason of the Figure of the resultant Corpuscles, and their fitness to convene when dissolv'd in Water, into curiously shap'd Bodies, this factitious Salt, when I have rightly prepar'd it, did sundry times shoot into long Christals with points like Diamonds, that did emulate native Christal as well in the regularness of the shape, as in the transparency of the substance. And to make it the more evident, That 'twas partly the Figure, that happen'd to result from the operation of the Oyl of Vitriol upon the Sea-Salt, and partly other Circumstances, that determin'd the shape of the Christals; I shall add, that usually, when the Quality or proportion of the Oyl of Vitriol was other than it should have been, or an errour was committed in some (important) Circumstance

ſtance or other of the Operation, the Saline Concretions, though they did not ſhoot at all like Cubes, as the Sea-Salt, which they were made of, would alone have done; yet they did not ſhoot any thing at all like Rock-Chriſtal, as did thoſe formerly mentioned; and for all this did, by reaſon of the curious Shapes of the Corpuſcles, they conſiſted of, ſhoot into Chriſtals for the moſt part finely Figur'd; though ſometimes of one ſhape and ſometimes of another. And that you may not have any ſuſpition as if the regular Figure, which Sea-Salt is naturally of, is any way neceſſary to ſuch figurations, I will add an Experiment that I devis'd to ſhew, That even out of a petreſcent Juice ſuch curiouſly figur'd Bodies may be made. I took then ſome Stony *Striæ*, elſewhere mention'd to have been found in Caves or Grottoes where petreſcent Liquors coagulated before they have time to fall down, and having diſſolv'd them in Spirit of Verdigreaſe, I put the clear Solution to evaporate in a Digeſtive Furnace after the ordinary man-

manner; by which means, though I made the Experiment more than once, I had rather a coagulated Mass than any thing like Christals. Whereby you may learn the truth of what I was saying, That a Concourse of divers circumstances may be requisite to determine the figuration of consistent Bodies, made out of fluid ones: since here, for want of time for making occursions enough for the Particles to concrete in after the most convenient manner, the Experiment succeeded not: Wherefore it being agreeable to my notions, that some sorts of Bodies may require a longer time to make such a Convention in, than others, I allow'd many daies to another solution of *Stiriæ* made in the same Menstruum; after which there shot, as I desir'd, about the sides and bottom of the Glass a number of distinct Christals, long, transparent, and curiously shap'd, most of which, I think, I can yet shew you.

Perhaps 'twill be said, that the petrescent Juice, when broken, does oftentimes appear to abound, within, with

with *ſtriæ* or narrow ſtreaks like thoſe of Antimony, and that I my ſelf obſerve ſome Gems to be made up of thin flakes or plates; which internal figuration ſeems to be much more difficult to be accounted for without a Plaſtick Form, than the External.

I will not reply to this, that, for ought I know, divers known Salts would, when broken, appear to be Geometrically figur'd ev'n in the leſſer Corpuſcles as well as they are evidently ſo in their entire bulk, if we had eyes quick enough to diſcern the Shapes of the minuter as well as of the bigger Bodies. And we have great Inducements to think, that whether or no *Carteſius* do rightly make the inviſible particles, of which the ſmalleſt viſible Grains of Sea-Salt are made up, to be long and rigid like ſticks; the minute viſible concretions, of which the bigger Grains of Salt conſiſt, are as well as themſelves of a Cubical figure; I will not, I ſay, inſiſt on this reply, but proceed to alledge, That there are divers Bodies ſo luckily ſhap'd, that upon a ſlow Coalition, they will

will convene into a multitude of manifeſt Concretions; ſome of which will conſiſt of ſtreaks, and others be made up of Flakes; as in the Sal-armoniack, commonly ſold in the Shops (for I ſpeak not of the native, that is ſaid to come from *Armenia*,) though it be avowedly a Factitious Body, you may often obſerve, upon breaking the bigger Maſſes, great multitudes of ſtreaks, like thoſe we may uſually obſerve in the broken *ſtiriæ* of petrifying Water. And I have more than once ſeen, and alſo made, artificial Concretions (of whoſe preparation I elſewhere ſpeak) ſome of which conſiſted of Salts alone, and others of Salts and Minerals, as Stones or Antimony, which look very like Talk, being white Bodies, made up of a multitude of very ſlender ſtreaky Particles lying long-wayes one upon another, as in that Mineral. And as I have taken out of Earth many Concretions, which as they were for the moſt part outwardly ſhap'd like *Rhombus's* or Lozenges, were compos'd of a multitude of flat and extreamly thin plates;

plates; ſo I have ſometimes taken pleaſure to imitate ſuch Concretions by Art. And though a Solution of Silver in purify'd *Aqua Fortis* does uſually afford only a great company of ſmall, thin and ſeemingly ſimple Flakes, like Scales of Fiſh, becauſe Men have not any deſign like ours in procuring the Concretion; yet having diſſolv'd a good quantity of the Metal together, and ſuffer'd it to ſhoot leaſurely and with due Circumſtances, I have obtain'd ſundry Chriſtals, which both were Geometrically figur'd without, and conſiſted of a multitude of exceeding thin Flakes orderly ſticking to one another. And I remember, That whilſt the Objection, I am anſwering, was in my thoughts, I pitch'd upon a yet more pregnant Experiment for the clearing of it. For conſidering, how *Tin-Glaſs*, though a compact and ponderous Body, does naturally conſiſt of a multitude of ſhining poliſh'd Flakes, (which may be eaſily perceiv'd and diſtinguiſh'd by breaking a Lump of it into three or four pieces;) I found by tryal

tryal what I expected, That though a mass of this Mineral were beaten to Powder, yet if it were melted and suffer'd to cool of it self, the disposition of the Component Particles would determine them to stick to one another in broad and shining Flakes, whereof many will be incumbent one upon another, and some cross to one another at various Angles, according as the matter happen'd in its several Portions to be diversly refrigerated. And some Factitious Bodies may afford us the like Instances, as I have observ'd in some mixtures of Copper, Iron, and other Minerals; and very conspicuously in good *Regulus Martis Stellatus*, whose Internal Configuration may be found by breaking it; by which way I have observ'd with pleasure, That the *Regulus* abounded with flat and shining Flakes of an almost specular Polish.

If it be urg'd, to confirm the former Objection, That some Lapidescent Juices, ev'n of those we mention'd in these Discourses, do concrete even whilst Men are looking on; and yet our Stony

Stirie,

Striæ, often mention'd (which probably may be alſo haſtily Coagulated) have in ſome places a Streaky and in other places an Angular Configuration of parts; I anſwer Firſt, That I have ſeen divers of that kind of Concretions, which as far as the eye took notice of, were made up of parts confuſedly jumbled together. And next, That (to conſider now thoſe whoſe Texture is more uniform) I have found by Tryals, that, if there be a due diſpoſition in the component Corpuſcles of Bodies to ſuch Configurations, they may be brought to concrete accordingly in a far ſhorter time, than almoſt any, that have not try'd, would expect, not to ſay, believe. Having ſometimes for Curioſity's ſake warm'd ſix or ſeven Ounces of *Aqua Fortis*, glutted with fine Silver, 'till the mixture was all brought into a tranſparent Liquor; and having then put the clear but ſtrong Glaſs, that contain'd it, into cold Water, that the Menſtruum might be the more haſtily Refrigerated, I obſerv'd, That when once the diſſolv'd Metal began to ſhoot, the

the Coagulation into figur'd Christals proceeded so fast, that a naked Eye could see the progress of it. And having sometimes put a quantity of Salt and Snow, or of some other strongly Refrigerating mixture, into a convenient Glass, and wetted the outside with a strong Solution of Sal Armoniack or some Urinous Spirit, though in less than a Minute of an Hour it would be Coagulated; yet the Salt, into which it shot, had usually a curious and determinate Figure according to the Nature of the Liquor that afforded it; as I have often shew'n the Curious.

Perhaps you will say, that these Instances are taken from Saline Bodies, which are for the most part dispos'd to convene in smooth Surfaces, and angular Shapes, and easie enough to be wrought on by the External cold; and it may yet seem strange to Philosophers themselves, what in some Cases must have happen'd, if our Hypothesis be admitted, namely, that external Circumstances and Accidents, such as the Figure of a Mold or Womb, the coldness

neſs of the Ambient, &c. ſhould viſibly, and ſometimes not a little, diverſify even the internal figuration of cloſe and ſolid Minerals and Gems, without excluding all thoſe that are ſuppoſed to be of a quicker Concretion.

Wherefore to clear this difficulty, it may not be a miſs to ſubjoin an Experiment, that I deviſed to ſhew, that if the Corpuſcles of a Body be ſo ſhap'd as to be fitted by their coalition, to conſtitute ſmooth (and if I may ſo ſpeak) gloſſy Planes, though they be variouſly ſhuffled and diſcompoſed as to their Priſtine order, yet if they be but a little while kept in a ſtate of fluidity, that they may the fitlier place themſelves or be placed by other Agents, they will preſently be brought to convene into ſmooth and ſhining Planes, and the Situation of thoſe Planes, in reference to one another, will be more Uniform and Regular, than almoſt any one would expect in a Concretion ſo haſtily made; notwithſtanding which, their internal contexture will be much diverſified by circumſtances, as parti-

cularly the figure of the Veſſel or Mold wherein the fluid Matter concretes.

Conſidering then, that (according to what I noted already) if we break *Tinn-Glaſs* (taken for the *Biſmuth* of the Ancient Mineraliſts) as 'tis wont to be ſold in Lumps in the Shops, it will diſcover a great many ſmooth and bright Planes, (larger, or leſſer, according to the bigneſs of the Lump;) which ſometimes meet, and ſometimes croſs one another at very differing Angles: conſidering this (I ſay) I thought it probable, that a Body, that had already been melted, and was apt to convene into ſuch Planes, not onely would do ſo upon another fuſion, but might have the order and bigneſs of thoſe Planes, diverſified by the Figure and capacity of the Veſſel, I ſhould think fit for my purpoſe. Wherefore having beaten a ſufficient quantity of it to powder, and, when 'twas well melted, caſt it into a good pair of Iron-Molds, whoſe Cavity was an Inch in Diameter, we had a Bullet, which, being warily broken, did, as we expected, ſeem to be,

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as it were, made up of a Multitude of little ſhining Planes, ſo ſhaped and plac'd, that they ſeem'd orderly to decreaſe more and more as they were further and further removed from the Superficies of the Globe; And they were ſo rank'd, that they ſeem'd to conſiſt of a multitude of theſe rows of Planes reaching every way, almoſt like ſo many *radius's* of a Sphere from the Centre or middle part, to the Circumference: Whereas if we melt Tinn-Glaſs in a Crucible and let it cool there, the Matter being taken out and broken, will appear indeed full of ſmooth Planes, but (as was lately intimated) very irregularly and confuſedly aſſociated or plac'd.

I will not now ſtay to enquire, whether the orderly compoſition of the Planes in our Bullet (which ſome curious Perſons, that I ſhew'd it to, look'd on, as a not unpleaſant ſight,) may be deriv'd from this, that the Matter was coold firſt on the outſide, by the contact of the cold Iron Mold, and the neighborhood of the Ambient Air, and

that the coagulation being once thus begun, the parts of the remaining fluid, as they happen'd to paſs by this already coold Matter, with a motion, which, by reaſon of their removal from the Fire, was now ſlacken'd, they were eaſily faſtened againſt the already ſtable parts, (as may be illuſtrated by the concretion of diſſolv'd Nitre and Allom, both about the injected ſticks, and the Grains that firſt concrete againſt the ſides of the Veſſel,) and the refrigeration ſtill reaching further inwards, till it came laſt of all to the middle of the Globe, that being the remoteſt part from the refrigerating Agents; the appoſition was ſucceſſively and orderly made, till the whole Matter was concreted. But, (as I was ſaying) I muſt not now ſtay to inquire, whether the figuration of our Bullet may be explain'd after this or ſome ſuch way: or whether we are not to take in ſome ſubtle or all pervading matter, or ſome other Catholique Agent? For though ſuch points may be well worth diſcuſſing, and we may poſſibly elſewhere ſay ſomething of them;

them; yet here it may ſuffice to ſay, that we have varied the foregoing Tryal by caſting Bullets of ſome other Bodies, (and particularly the ſimple *Regulus* of Antimony) wherein it ſucceeded well enough, though the produc'd contexture were not ſo Uniform as in *Tinn-Glaſs*. And I alſo try'd, that having caſt melted Sulphur it ſelf into a Globous Body of about five or ſix Inches in Diameter, and warily broken it, though one would think it an unlikely Mineral to make any other than a confus'd Concretion, it preſented me great Fibres almoſt like little ſtrawes, whoſe number and (in great part) orderly ſituation afforded me a much leſs unfit Inſtance for my preſent purpoſe than one would have lightly expected. But what I came from ſaying, may ſerve to make out what I propounded to my ſelf; which having named already I need not here repeat.

But one thing more there is, that may be pertinent on this occaſion, namely, That I have broken divers Marchaſites of a peculiar ſort, that were either of

a roundish, or of an almost Cylindrical Figure, to observe their internal Structure and Qualifications; whereupon, I found in more than one of them (for I remember not that I did in all) a great many rowes of little Planes or glistering Corpuscles, reaching from the innermost parts to the External Surface, and in those that were somewhat Cylindrically shap'd on the outside; these ranks of Gold-colour'd particles in the several Planes of the broken Mineral, seem'd like Semi-Diameters issuing out from a row of Physical Points, conceived to be plac'd on an imaginary Line, lying almost like the *Axis* of a *Cylinder* between the opposite ends, (though I do not well remember how near it reach'd to them:) As if the Cavities of the Chalk or Clay, wherein these Marchasites were found, had made the Soil like a Mold, wherein the Matter of the Marchasite being detained whil'st 'twas in a Fluid form, did afterwards concrete much after the manner that the Bullets of Tinn-Glass, *Regulus*, *&c.* did in our Molds. But the prosecution of this Con-

Conjecture belongs to another Diſcourſe.

I ſhall therefore now proceed to a further Anſwer to the formerly raiſed Objection: Wherefore as to the exquiſite uniformity of Shape, which is ſo admir'd in Gems, and is thought to demonſtrate their being form'd by a Seminal and Geometrizing Principle; though I have, in the Second of the above mention'd Arguments, aſcrib'd to them ſuch curious Figures, as argue their having been generated after the way propos'd in our Hypotheſis; and though alſo I willingly allow their ſhapes to deſerve from us a delightful Wonder at the curiouſneſs of Nature's, (or rather her Author's) Workmanſhip; yet upon a more attentive ſurveying of them, I do not find the Uniformity to be near ſo great as is wont to be imagin'd; but have rather met with ſuch Diverſities as agree well with our Hypotheſis about their Figuration.

In ſeveral tranſparent Gems, it ſeem'd manifeſt enough to me, (as I lately alſo noted) that the Shape was, in great part,

due to the Figure of the Womb, or Mold, wherein the matter, whilst liquid or soft, happen'd to settle. In some other transparent and well figur'd Gems of the same kind or Denomination, and sometimes growing very near one another, by a diligent Inspection I found a manifest and sometimes very considerable Difference in their shapes, either as to the Number, or the Figures, or the bigness of the Sides or Planes that made up the respective Gems; or as to two, or all, of these; comparing these deviating Particulars with what would have been in a Stone of that kind or Denomination, that were perfectly figur'd. This I had oppotunity to take notice of, particularly in two sorts of Stones; the first *Granats*, of which I had a considerable number brought me out of *America* growing in one Lump of Matter; but in distinct parts of it, and without touching one another: Among which I took notice of a manifest disparity of shape, and so I did in some *Affrican* ones, that were presented me; as also in others that were *European*, one of

which, that was of an extraordinarily large ſize for a figur'd Gem of a tranſparent kind, (for it weigh'd above *Eleven* Drachms and a half,) I conſider'd with a particular attention, and found, that, though it ſeem'd to have been coagulated in a Fluid *Medium*, and to conſiſt of Twelve Planes, at the concourſe of two or three of which it ſeem'd to have been broken off from the Womb or Root; yet it was very far from the *Dodecahedron* of Geometricians: For, whereas that conſiſts of Twelve æquilateral and æquiangled *pentagons*, almoſt all the Planes, that made up our Granat, were quadrilateral and very different from what regularly they ſhould have been, not only in magnitude, but in ſhape: for one of them ſeem'd to have five Sides, and of the reſt, ſome were moſt of kinn to a *Rhombus*, others to a *Rhomboeides*; but the moſt were but little better figur'd than thoſe that the Geometricians call the *Trapezia*. And thus much for the firſt ſort of Gems whoſe ſhapes I obſerved to be not regular. The Second conſiſts of

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thoſe Chriſtalline Stones, which they call *Corniſh Diamonds*, and which are ſome of them much harder than the *Briſtol Diamonds*, or perhaps than Rock-Criſtal it ſelf; it being eaſie to write upon Glaſs with them. Of theſe Stones having procur'd a good number (many of which I have yet by me,) I took notice, by comparing them heedfully together, that though ſome of them were Geometrically and curiouſly ſhap'd like Rock-Criſtal, having each ſix ſides, whereof every two, that were oppoſite, were throughly like and equal enough to one another; and though the Stone had a Pyramidal termination, made up by ſeveral reſembling and curiouſly figur'd Planes, that terminated in a ſolid Angle or Apex; yet the greateſt number, by much, of theſe Titular Diamonds was made up of Stones, far from being ſo exactly and uniformly ſhap'd, as thoſe newly deſcrib'd. For though moſt of them had ſix long Planes; yet oftentimes the oppoſite ones (beſides that they were not ſo parallel to one another, as they ſhould have

have been) were unlike and exceeding unequal; and those Planes, that went to make up the *Apex*, though a part, they were usually angular; yet being compar'd to one another, or to the Regular Patterns above mention'd, their Figures, their Bignesses, and their manner of concurring (which was sometimes not in a Point or *Apex*, but in a Line,) was so remote from being uniform, that this great diversity and irregularity agreed far better with our Hypothesis, than with its Rival. And yet in these Stones, the want of room to coagulate freely in, could not with probability be pretended; for they seem'd to have been form'd separately in a fluid Ambient, save at the bottom, where they were fasten'd to the Rock, as appear'd by an opacous Root, if I may so call it, which still adher'd to most of them. And, if I much misremember not, I have more than once in Diamonds, newly brought from the *Indies*, and some of them very fair ones, observed a great want of Uniformity in the *Area's* of the Superficial Planes, or in their Figures,

or

or both; and ſometimes too in the very number as well as Situation of their Solid Angles or Corners: about which I hope to recover ſome Notes. And ſo I have done with the *firſt* part of my Anſwer to the above mention'd Objection; whereby it may appear, that there is no ſuch regular and conſtant Uniformity in the Shapes of Gems, but that their Real Likeneſs may be reconcil'd to our Hypotheſis.

But now in the *Second* part of my Anſwer, I ſhall endeavour to ſhew, that the Figuration of Gems may not only *conſiſt with* our Conjectures, but *confirm* them. For, I have more than once taken notice in the *Corniſh* Diamonds I have been mentioning, that ſometimes a ſmall Stone of the ſame kind, has made up, as it were, one Body with a greater; ſo as that the leſſer Stone did not only adhere cloſely to the other, but was, if I may ſo ſpeake, Set or Bedded in it. So that when the Separation was made, there remain'd in the greater Stone a Cavity, whoſe Figure did curiouſly anſwer that of as much of the ſmaller Stone,

Stone, as chanc'd to be harbour'd there. And, as ſometimes I obſerv'd, that there was ſuch an adnaſcency, (if you will pardon the Word,) of a Leſſer Stone to a much Greater; ſo at other times, I met with the like of a Greater to a much Leſſer, with a Cavity in the Leſſer, anſwerable to that part of the Greater that had been lodg'd in it. Which, for ought I know, allows us with high probability to conjecture, that the Stone, to which the other grew, was firſt form'd and harden'd; ſince it retain'd its own ſhape, and that, whilſt this remain'd adherent to the Rock or Soil, ſome more Liquor, either that came afterwards by chance into the ſame Cavity, or (in caſe 'twere there before,) that was leſs diſpos'd to an early Concretion, began to coagulate by faſtening it ſelf againſt the Solid Body that was already concreted: Upon which account theſe two Diamonds muſt ſtick cloſe together, and yet be but Contiguous, and a Cavity, ſuch as I freſhly mention'd, muſt be left in the laſt concreted Gem. Which may be illuſtrated by putting into

to a ſtrong ſolution of pure Nitre, or Rock-Allom, ſome little ſticks of Wood or any ſolid Body, that may be kept ſteadily in the ſame poſture; for you will ſee many coagulations begin to be made againſt them, and the Criſtals thus concreted will neceſſarily have their Figures incompleat, and have in them Cavities correſpondent to thoſe Parts of the Stick, whereto the Saline Corpuſcles faſten'd themſelves. To which I ſhall only add, that though I have given Inſtances of the adnaſcency of figur'd Stones only in *Corniſh* Diamonds, yet they are not the only tranſparent Minerals, wherein I have been able to obſerve it. And particularly I remember, that I obſerved among ſome Minerals left by a *Gold-Smith* to his Widow, a Fine tranſparent and neatly figur'd Stone, which ſeem'd to be pure Criſtal, but was coagulated about a kind of branching Wire, whereof a good part was incloſed by the Stone, that ſeem'd to grow out of a piece of Ore, that look'd like Silver-Ore, and which the Woman, that was

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a curious Perſon, upon the ſtrict Inquiry that I made, affirm'd to be, together with the above-mention'd branch, good Silver, produc'd by Nature in that form, (which I thought the more credible, becauſe of the odd and almoſt hairlike ſhape wherein I have ſeen Silver-Ore to have as it were grown;) which will excellently agree with the Reſemblance, I was juſt now propoſing betwixt the coagulation of diſſolved Salts and the liquid matter of Gems, about ſtable Bodies partly immers'd in thoſe fluids.

The very many Circumſtances belonging to our Firſt Argument, and the laſt anſwer'd Objection, have ſo long detain'd us, that I doubt, you now think it more than time I ſhould advance to, and diſpatch the *Second* of thoſe Grand Conſiderations, whereon I at firſt intimated our Hypotheſis was founded; And this is built upon the *Weight* of ſome Gems, which being greater than that which ſeems to belong to them as hard and tranſparent Stones, I think we may probably derive it from Metalline or Mineral Mixtures.

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I queſtion not, but as you will think this allegation new, ſo you will be apt to queſtion, how I come to know the Truth of what I here deliver; ſince, though Gems are wont to be eſtimated by Lapidaries, as they weigh ſuch or ſuch a Number of Carrats, or of Grains, yet they compare only the weight of this and that Stone of the ſame kind in reference to one another, as the greater or leſſer weight argues the greater or leſſer Bulk, without looking after or knowing how to diſcover the *Specifick* Gravity of ſeveral Gems which depends not on the greater or leſſer Bulk; as (if you know it not already) you will gather from what I am now going to relate.

Conſidering then with my ſelf, that for my purpoſe, it was requiſite to have a Gem as free as I could get from the Metalline Mixtures, that I ſuſpected many pretious Stones to have; and remembring, that Rock-Criſtal, as it is by Mineraliſts reckon'd among Gems, ſo it is hard enough, as I try'd, both to cut Glaſs, and to ſtrike fire, and that its having

having ſo great a tranſparency, and its being devoid of Colour, makes it exceeding likely to be free from adventitious mixtures; I pitch'd upon it as the Standard whereby to make a *probable* eſtimate of the weight of Gems; and having Hydroſtatically and with a tender Ballance examin'd the weight of it, firſt in the Air, and then in Water, I found its weight to be to that of Water of equal Bulk as *two* and almoſt *two thirds* to one: Which, by the way, ſhews us, how groundleſsly many Learned Men, as well Ancient as Modern, make Cryſtal to be but Ice extraordinarily harden'd by a long and vehement Cold; whereas Ice is bulk for bulk lighter than Water, (and therefore ſwims upon it) and (to add that Objection againſt the vulgar error) *Madagaſcar* and other Countreys in the Torrid Zone abound with Cryſtal.

Having thus found the Ponderouſneſs of Cryſtal in reference to Water, when I met with a colour'd Gem, whoſe Specifick Gravity I gheſs'd to be ſenſibly greater; I ſometimes gave my ſelf

the trouble (for a trouble 'tis) to weigh them in the Air and in the Water, and ſo diſcover, whether I conjectur'd aright. And if its Specifick Gravity did much exceed that of Criſtal, I thought it a probable Argument, that there might be ſome Metalline or Mineral Corpuſcles mingled with the ſtony Ones of the Gems, and that alſo it may probably derive its Tincture thence. I will not tell you, that I then found many ſorts of tranſparent Stones *much heavier* than Criſtal: For, beſides that the Tryals were troubleſome enough to make, I chanc'd to fall upon them in a place, where I had not any *ſtore* and *variety* of Gems to examine. But one Inſtance among thoſe that occurr'd to me, I ſhall here ſet down, becauſe being ſo notable, it may ſuffice to ſhew, that, as to *ſome* Gems at leaſt, my opinion of their having an Adventitious Gravity, and conſequently Ingredient, is very probable. I had ſome *American Granats*, which I had a great and peculiar Reaſon to believe had been once Liquid Bodies, and therefore thought them the more worthy

thy to be examin'd; and finding their Colour to be ſo deep, that they were almoſt opacous, and judging by my hand, that they were much heavier than pieces of Criſtal of the ſame Bulk would be, I weigh'd them in a pair of nice Scales in the Air and in the Water, and found them, as I expected, to be almoſt four times as heavy as Water of the ſame Bulk, and conſequently heavier by about a third part than pieces of Criſtal, equalling them in bigneſs, would be. Whence ſo great an acceſſion of ponderouſneſs proceeded, I ſhall tell you, when I come to my next Argument; to which I ſhall advance, as ſoon as I have noted, that though, when colour'd Gems have a greater Gravity than Criſtal, 'tis a probable Argument, that they have ſome Metalline Pigment or other Mineral ſubſtance mingled with them; yet if ſuch Gems have no ſuch ſurpluſage of weight, it will not follow that their Colour cannot proceed from any Mineral Tincture; ſince 'tis not unreaſonable to conceive, that a Mineral Subſtance may be preſent in a Liquor (ſuch as the

Lapideſcent Juice,) that we ſuppoſe Gems to be made of, even when it adds no manifeſt weight to the Body that harbours it; ſince I have obſerv'd (what is odd,) That a Mineral Water, which by its Taſt, its Effects, and the Colour it would ſtrike, appear'd to be richly impregnated with Iron, being carefully by me examin'd Hydroſtatically, did appear very little, (if at all) ſenſibly heavier than Common Water.

The *Third* and laſt Argument, I ſhall now make uſe of, is taken from hence; That out of divers Medicinal Stones, and ev'n out of ſome fine Gems, real and Corporeal Metals, or other Mineral ſubſtances, may be extracted.

Of this Argument I ſhall at preſent ſay the leſs, becauſe the further proſecution of it will be more proper in the Second Part of this Diſcourſe, where I ſhall be oblig'd to handle it with reference to opacous Gems, in which its force will beſt appear. And therefore I ſhall deſire you to take notice, when you arrive at that Part of the ſubſequent Diſcourſe, of thoſe particulars, that may

may ſerve to ſtrengthen the newly propos'd Argument: And if it be objected, that the Bodies, there treated of, are opacous Stones, not Gems, I have theſe things to anſwer.

Firſt, that divers Stones, that are reckon'd amongſt precious ones, are *opacous* too; as the *Turquois*, the *Onyx*, the *Sardonix*, &c. not to mention divers others, as *Cats-Eyes*, *Opales*, &c. which are as it were Semi-opacous. Beſides I much queſtion, whether Diaphaneity be abſolutely neceſſary to the Eſſence, though it be to the Beauty, of thoſe precious Stones, wherein 'tis uſually found. And I might here make it probable by diſcourſe, that tranſparency and opacity oftentimes depend but upon the manner of the Pigments, diſperſion thorough the ſtony matter of the Gem, and the convenient or inconvenient ſituation of the pores in reference to the beams of Light. But waving this ſpeculative Argument, I ſhall rather take notice, that ſeveral precious Stones, and even Diamonds themſelves, have ſometimes great clouds, which make

make them in thoſe parts almoſt (if not quite) opacous, without being thereby hinder'd from being true Diamonds or Gems, of this or that kind, to which their hardneſs, colour, &c. makes them appertain: And not to mention *Cornelions*, *Agats*, and ſome other Stones that we may obſerve to be (as the tinging Corpuſcles happen to be in a due or an over-great proportion mix'd with the petreſcent matter, and to be Uniformly or inconveniently mingled with it,) ſome of them tranſparent and ſome of them ſemi-diaphanous; I have ſeen worn in a Ring a *Sardonix* it ſelf that was tranſparent, as unlikely a Gem as that is to be ſo. And as for *Granats*, though you know, that both of them are Diaphanous; yet I have had ſome figur'd ones, that ſeem'd quite opacous: and I have others by me of ſeveral Countreys, (where of one very remarkable for its large ſize and Geometrical ſhape,) that are in ſome places Diaphanous, but as to the main bulk of their Bodies appear at leaſt almoſt as dark as ordinary Stones.

I further add, that I little doubt, but that experiments, not unlike thoſe, I ſhall hereafter tell you, I try'd to obtain Mineral or Metalline ſubſtances from Load ſtones, native Cinaber, Blood-ſtones, &c. might ſucceed in ſeveral other of the more ponderous Gems, if it were not that the Glaſſy Nature, or exceeding compactneſs of many of them, makes the Mineral Corpuſcles, that are harbour'd in the ſtony and inſoluble parts, to be inacceſſible to our *Common Menſtruums*. And when the Metalline and Mineral ingredient is very abundant, and the Tincture of the ſtony parts not ſo very cloſe, I queſtion not, but even from tranſparent Gems the adventitious Ingredient may, in part at leaſt, be diſſolv'd. And to ſatisfie you about this matter, I ſhall now inform you, that having by the ponderouſneſs of the lately mention'd kind of Granats been induc'd to conclude them impregnated with ſomewhat Metalline, and for that reaſon to think it fit to try, whether I could ſeparate it from them, or otherwiſe diſcover it in them; I kept ſome of

them (in a crucible) for a competent time in the fire, and found, that they had exchang'd their Colour, for one not unlike that of unbrightned Iron; and having reduc'd them to very fine powder, and digested some acid Menstruums and particularly rectifi'd Spirit of Salt upon them, they afforded me a rich Tincture: Encourag'd by which, I hop'd, that, without their being previously burnt, they would in *Aqua Regis* afford a Tincture, and accordingly I obtain'd from crude Granats, (only reduc'd to very fine powder) a rich Solution, which though in colour it somewhat emulated a Solution of Gold; yet partly by the Colour of the burn'd Granats and partly by the Taste of this Solution, I suppos'd, that another Metal was likelier than Gold to be the predominant Mineral; and having gently evaporated part of that Menstruum, I obtain'd from some of the rest certain Crittals, whose shape by reason of their smallness and disorderly coagulation, I could not well determin; and touching with the Tip of my little Finger the uncoa-

uncoagulated portion of the Liquor, this part of a drop, being put to a great many drops of the Infuſion of Gall, did ſo immediately turn it into a ſubſtance that ſeem'd full as black, if not blacker than Ink, as you would, I think, have been ſomewhat ſurpriz'd to behold.

Which tryal I made to examin the conjectures I had, that one Mineral (for perhaps 'twas not the only, that help'd to conſtitute theſe Granats, was of a Martial nature; which, if it were, I ſuppos'd it would, like other Bodies that participate of Iron, afford with Galls an Inky colour. I tryed alſo with a parcel of ſmall and red tranſparent Stones, which ſome gheſſed to be *Granats*; others, more probably, *Rubies*, that being finely powder'd, they would in an appropriated *Menſtruum*, (made extraordinary ſtrong) give a Colour like that of diſſolv'd Gold. And that there were really ſome parts of the Gem diſſolved in the *Menſtruum*, appear'd not only by the above mentioned colour, but by theſe two indications: The *one*, that having put ſome of this Liquor

Liquor to some of the same solution of Galls, I just now spoke of, it produced indeed, at the very first, a dark Colour, but not neer so black as that of the *Granats*, and in a trice let fall a copious precipitate that was almost white: The *other*, that I was able to precipitate from it, by an urinous Spirit, a reddish substance, which being suffer'd to dry in Air, seem'd to grow into Bodies, in shape not unlike Moss, and here and there small Mushrons, all of them prettily colour'd. And from certain *Granats* that were in some places opacous, as well as in others Diaphanous, I obtain'd a Solution from whence the superfluous Liquor being abstracted, the residue, which was deeply coloured, did in the cold afford me a kind of saline concretions, which yet were not large enough to inable one to determin their Figures.

And on this occasion I hold it not unfit to intimate, that perhaps, if Men had curiosity enough to make tryals, there would be other transparent Minerals found capable of being wrought on by ap-

appropriated *Menstruums*. For, I do not think, that every seemingly glassy contexture of a Mineral makes it unfit to be wrought on: For though the clear *Spar*, which in most of our Western Lead-Mines in *England* is found next to the Metalline Veins, be at least Semidiaphanous, and be of so glassy a contexture, that it usually breaks into smooth and glossy *Superficies*, and looks like a *Talk*, and also for the most part is made up of and presently reducible into Geometrically figur'd Bodies, shap'd like *Rhombus's* or *Rhomboides*; yet some other Tryals, that I have made with this *Spar* inducing me to suspect, that 'twas not indeed a *Talk*, but a Body of a much more open Texture, I found, I could dissolve it in several Liquors, and particularly in good Spirit of Salt, which would presently work upon it, even whil'st it was in Lumps, and that without the assistance of Heat; which Observation may perhaps give some incouragement to such a curiosity as yours.

But by what I have said of the use-

fulness

fulneſs of *Menſtruums*, I would not have you think, that they are the only Inſtruments, wherewith ſomething Metalline may be obatin'd from ſome Gems: For in an other Paper of mine (to which ſuch tryals more properly belong) you may find an account of ſome attempts of that kind by fuſions and appropriated additaments. And however ſuch Tryals may ſucceed with you that aim at *ſeparating* from a Gem a Metalline or Mineral Body of a determinate *ſpecies*; I can teach you an eaſie way, whereby I have (by the help of fuſion) more than once *manifeſted* in the General, that there may be ſubſtances, partaking of a Metalline nature, in ſome kinds even of tranſparent Gems. And partly by the ſame way, and partly by ſome others, I have been able to determin probably enough, in ſome caſes, that the Mineral ſubſtance is predominant in it.

And here, before I diſmiſs the firſt part of our Eſſay, I think I may poſſibly ſomewhat illuſtrate our *Hypotheſis*, if I briefly mention to you an experiment,

I remember I once made to that purpose. And it was this: I reduc'd to powder some of those *Stiriæ*, that I have often spoken of, of water petrified, as it were, spontaneously: I also consider'd with my self, that I had found Spirit of *Verdigreas*, (which I make without the tedious preparations, that *Basilius* and others prescribe, by barely distilling without additaments good French *Verdigreas*, and rectifying the obtained liquor) I had, (I say) found this *Menstruum* to be not only (as I elsewhere observe) a good solvent for many Bodies, but also to be distillable from many of them, without leaving near so much of it self behind, as other Saline Solvents are wont to do: Considering this, I say, I dissolved the stony *stiriæ* in this Liquor, and having suffer'd some of it to evaporate away, and put the rest into a cool place, I obtained, as I expected, store of small but finely figur'd and transparent Cristals, that shot much after the fashion of those of the purer sort of Nitre. With some part also of the stony solution I mixed, in a convenient

nient proportion, a high colour'd ſolution of Copper, made likewiſe in Spirit of *Verdigreas*; and theſe two ſolutions being made with the ſame Menſtruum, and warily enough put together, did not precipitate one another, but afforded me, upon the evaporation of the ſuperfluous moiſture, among divers Criſtals that were tranſparent and colourleſs, ſome that were richly adorned with a greeniſh blew Tincture of the diſſolved Metal. What tryals I made by this way, little varied, to imitate nature by aſſociating into tranſparent Bodies ſtony and metalline Subſtances, I cannot now give you a full account of; ſince I neither have by me the Notes, I ſet down about thoſe tryals, nor think it fit to make this firſt part of our Diſcourſe more prolix, than I now perceive it to be already.

SECT. II.

Containing a Conjecture about the Cauſes of the Virtues of GEMS.

WHat has been hitherto deliver'd in the firſt part of our Diſcourſe, will, I ſuppoſe, make it allowable for me to be more ſuccinct in the Second. I ſhall now therefore proceed to thoſe other conſiderations, which, being aſſiſted by what has been already ſaid, may, I hope, ſuffice, to keep our conjecture about the Cauſe of the Virtues of Gems from ſeeming unreaſonable.

And my firſt Obſervation ſhall be, that not only there is in the Earth a great number and variety of Minerals, already

dy known by particular Names; but probably there are very many others that are not yet known to us.

The former part of this propoſition will not be doubted by thoſe, that conſider, how great a multitude of Metalline Ores, Marchaſites of ſeveral ſorts, Antimonies, Tinn'd-glaſs, *Fluores*, Talks of various Kinds, Spars, Sulphurs, Salts, Bitumens, *&c.* are mention'd partly by Chymiſts, and other Mineraliſts, and partly by thoſe that have given us accounts of *Muſeums* and other collections of natural Rarities; inſomuch that of only one Kind of Foſſils, the diligence of ſome modern Writers hath reckoned up between two hundred and two hundred and fifty; beſides Animal Stones, as *Lapis Bezoar*, *Lapis Manati*, *Oculus Cancri*, *Lapis Porcinus*, *&c.*

And as for the Second Part of our propoſition or obſervation, you will ſcarce deny it, though you conſider with me but theſe two things.

The firſt is the ſmall and inconſiderable proportion, that the perpendicular depths,

depth, that the generality of Mines bears, to the Semidiameter of the Earth, reckon'd to be above 3500 Miles; so that, though our Globe were inhabited by some hundreds of millions of men more than now it is, and they had curiosity enough to dig Mines every where, and consequently there were Millions of inquisitive and laborious men more than really there are, their Spades and Pickaxes would, except here and there, penetrate so little a way into the Earth, that a vast multitude of Fossils might, by lying deeper in the bowels of it, continue undiscover'd.

And to this First Observation I shall subjoin this Second, that, as far as I have observed, almost every Region affords Minerals of its own, differing from those that are taken notice of in other Regions. And in particular Countryes, as in some Shires of *England*, a curious and heedful Eye may, I doubt not, observe several that are not taken notice of by the inhabitants themselves, especially if well-made borers were diligently and skilfully imploy'd to

pierce the ground, and bring up Simples of divers Fossils that lye hidden under it. But having elsewhere discoursed of this matter, I shall here only tell you, in general, that in some parts of *England*, where I had more opportunity than in others, to exercise some Curiosity about Minerals, I met sometimes in a small compass of ground, with a much greater variety than I expected, and several of them undescrib'd, that I know of, by any Writer; of which sort I have received divers others from several parts both of the old world and the new.

In the next place I consider, that Nature has furnished the Earth with *Menstruums* and others Liquors of several sorts, and indowed it with divers qualities. This I have already manifested in the discourse of subterraneal Menstruums, whereto I shall therefore refer you; only taking notice in this place, that whereas water is abundantly to be met with under ground, and for the most part very copiously in Mines, by which it is capable to be variously impreg-

pregnated; this liquor it ſelf, eſpecially being thus alter'd, may in ſome caſes act the part of no deſpicable *Menſtruum*, and on ſome occaſions otherwiſe concur to the production of Mineral Bodies.

I further obſerve, that the ſubterraneal Liquors, upon one account or other, (for we need not now particularly determin it) are qualified to work either as Corroſive Menſtruums, or as other Solvents, upon many of the Medicinal Earths and other Minerals they meet with under ground: which Minerals, having never been expoſed to our fires, have their Texture more open, and their parts more ſoluble than thoſe, that have been melted by the violent heats of our furnaces.

And that even Common water will ſuffice to diſſolve, and impregnate it ſelf both with the Saline and oftentimes with Metalline parts, that it meets with in its paſſage, is obvious enough in the differing taſts and other qualities of liquors, that all paſs for common water, whereof ſome is found better and ſome

worse than others, to Brue, some to wash Linnen, some to Dye Scarlet, or other determinate Colours; some to temper Steel, and some for other uses.

But others unquestionably more eminent instances, are given us by the Mineral Springs, whether *Thermæ* or *Acidulæ*, as Authors distinguish those that are actually hot, (as at *Bath*) and those that are Saline and for the most part sowrish (like those at *Tunbridge* and the *York-shire Spaw*;) of which two sorts good store are enumerated by Physitians and Geographers; and of which a far greater number would be discover'd, if men wanted neither skill nor diligence. And here I shall desire you to take notice, that, though common water do the most readily dissolve the Salts more properly so called, though not altogether pure, it meets with in the bowels of the Earth, as we see it happens in those Salt-Springs that come not from the Sea; yet there are also many others subterraneal Bodies, which upon the score of their abounding with Saline particles, will be dissolved by water,

water, though they be of a compounded nature, and contain very differing ſubſtances; as 'tis plain in thoſe waters of *Hungary* and other Regions, which by the evaporation of their ſuperfluous moiſture, will yield Vitriol, a Mineral not only compounded but decompounded, as containing in it a Saline, a Sulphureous, a Metaline and an Earthly part, (which it ſelf I have found to be none of the ſimpleſt Bodies;) every one of which may be made diſtinctly to appear.

Laſtly, I conſider, that the Petrific Juice or Spirit coming to be in a ſufficient proportion mingled with theſe impregnated waters, ſo as to coagulate them, and concoagulate with them; from their coalition may reſult thoſe precious Stones that we call tranſparent Gems. For 'tis certain, that Bodies, that were a while before in the form of waters, may coagulate into ſtony *ſtiriæ*, of whoſe odorouſneſs and reducibleneſs into lime, I have already given an account in my diſcourſes of Lapideſcent Juices; of which you may com-

mand a ſight. And that even Diamonds themſelves, the hardeſt of Gems, were once fluid ſubſtances, the firſt part of this Diſcourſe has, I hope, evinced.

To which I ſhall now add, that procuring ſome petrified Bodies to be brought me from a place in *England*, which I could not be admitted to, I found, that the Petrific Juice or Spirit, that abounded in the Earth of that ſpot of ground, was ſo penetrating, and ſo operative, that it made ſome of the vegetable ſubſtances, that were found in it, in their priſtine ſhape, and, for ought I could perceive, bigneſs, hard enough to cut Glaſs as well as grave on Iron. And 'twas among theſe rarities (if I much miſ-remember not) that I pick'd up a (moderately) tranſparent Body (which I think I have yet by me) that, by the ſhape and other Circumſtances I judg'd to have been a diaphanous Gum, belonging to one of the pieces of petrified wood, that had been brought me, and was hardened to a degree that made it capable of ſcratching Glaſs.

And

And now to bring home these things to my present subject, I conceive, that some (at least,) of the *Real* Virtues of divers Gems may be derived from this, That whilst they were in a fluid form, (or at least not yet Hard'ned,) the Petrescent substance was mingled with some mineral solution or tincture, or with some other impregnated liquor, and that these were afterwards Concoagulated, or united and hardened, into one Gem, as a Diamond, a Saphir, a Granat, an Onyx, a Blood-stone, *&c.* And as divers of the Virtues of Gems may be in a general way deduc'd from the commixture of these Mineral Corpuscles; so the greatness of those Virtues and the variety of those properties in particular, may be ascribed to the peculiar nature of the impregnating liquors, to the diversity of them, and to the greater and lesser proportions, wherein they are mixt with the Petrescent juice.

To render this *conjecture* (for I propose it as no other,) thus summarily and briefly express'd, the more *probable*;

'twill be fit to recall to mind the Arguments, whereby we have already shewn, both that Gems were once fluid or soft Bodies, and that divers of them were not simple concretions of a Petrescent liquor, but consisted also of other Mineral adventitious Corpuscles: Which may appear, partly by the separableness of such substances from some Gems; (as we exemplified in Granats) *partly* by the specific gravity of others, and partly by the differing tinctures (whereof one at least may well be supposed adventitious,) to be met with in Gems of the same *species*, as Rubies, Saphirs, Granats and even (the hardest stones, that we yet know of,) Diamonds themselves; of which (as is before noted) I have seen some Yellow (and that to a great degree,) some of other colours, but not so vivid, and some Green, almost like Emeraulds.

Now *since* there may be in Gems, and in some of them abundantly such adventitious Corpuscles; and *since* there is cause to think, that some may be indowed with divers properties and Medical Virtues;

Virtues; *since* alſo there is a great difference among theſe impregnating particles and probably of a greater variety of them, than is known to us; *since* laſtly divers Gems are not ſparingly but richly impregnated with theſe innobling Corpuſcles, I ſee no ſufficient reaſon, why ſome of the Virtues of divers Gems are not more likely to proceed thence, than from thoſe unintelligible and precarious *ſubſtantial Forms*, to which they are wont to be referr'd.

But becauſe there are ſome difficulties, that the objections of others or my own thoughts have ſuggeſted againſt our *Hypotheſis*; though I neither have time, nor do think it very neceſſary, to diſcourſe amply of them: Yet to clear the way for what I am afterwards to repreſent, I ſhall (though I can but briefly do it) ſay ſomething to each, that may perhaps appear no inſufficient anſwer; eſpecially after I have declared, as I here do once for all, that I ſpeak of the True and Medical Virtues that belong to Gems; and that, as to thoſe Magical and other Extravagant properties, that either

either notoriouſly fabulous, or other credulous Writers have made bold to deliver, I am ſo far from pretending to afford them an Explication, that I do not allow them the leaſt degree of Aſſent.

This premis'd, let us conſider the chief difficulties themſelves; among which I doubt not but it will be objected, That it is not credible, that the Mineral Subſtances, wherewith our *Hypotheſis* would have Gems to be impregnated, ſhould have any Medical operation at all on the human body, in regard that they are ſo lock'd up that they can communicate nothing to it, eſpecially being indigeſtable and unconquerable by ſo ſmall a heat as that of the Stomach and other parts of the Body.

But to this ſpecious Objection I have ſeveral things to return by way of Anſwer. And firſt of all; had there yet never been any actual Tryal made, whereby to know, whether a Gem be capable of having any Medical Virtues, I confeſs I ſhould find probability enough in the Objection to ſuſpend my Judgement

Judgement, till experience ſhould determine the Queſtion. But ſince upon the very credible Teſtimony of eminent Phyſitians and Patients themſelves of my own acquaintance, I find much leſs cauſe to disbelieve, than to aſſent to ſome matters of Fact about the operations of Gems; and *ſince* ſuch matters of Fact do ſtrongly argue in the general, that a Precious Stone may have Medical Virtues; I think, the Objection, as 'tis propos'd in general, is ſufficiently enervated by ſuch particular inſtances, and ought not to keep us from believing upon Experience the poſſibility of the thing denyed; eſpecially ſince there are other things beſides, that may be alledg'd in favour of our *Hypotheſis*.

For it may be conſider'd in the next place, that vigorous Load-ſtones emit copious and very plentiful *Effluvia*; and yet, beſides that ordinary Magnets are uſually a very hard ſort of Stones, I have met with ſome Load-ſtones much harder than ordinary ones, and poſſibly than divers Gems. And 'tis farther

farther considerable, that there are Load-stones, (some of which I can shew you,) which do not only work upon Iron and other Magnetical Bodies, but have a manifest and inconvenient operation upon Human Bodies, by being worn in mens Pockets or long held in their Hands; as those, that have resented such operations themselves, and observed them in others, have complain'd to me; which I might confirm by some analogous observations, if I had time to relate them.

But now I proceed to observe, that among transparent Pebles, some of which, you know, are by being barely well Cut and Set, made to counterfeit Diamonds, I have found several, that may be brought in a trice to emit copious and even strongly sented streams. And if you allow the opinion of the generality of Modern Philosophers, who ascribe Electrical attractions to the *Effluvia* of bodies excited by rubbing, you will, I presume, allow me to infer, that very light alterations may suffice to procure Expirations even from transparent Gems:

Gems: Many of which are Electrical, and ſo are the hardeſt of them, Diamonds themſelves; one of which I keep by me, that upon a little friction attracts, vigorouſly enough to be wonder'd at by the Spectators.

And as to that part of the Objection I am anſwering, which contends, that Gems are not to be digeſted or conquered by the heat of the Stomach; I will not ſtay to examine, whether and how far the digeſtion of things in the Stomach be to be aſcribed to Heat, contenting my ſelf to ſay at preſent, that, to make the Objection valid, it ſhould be firſt proved, that ſuch Bodies cannot have any operation upon the human body as paſs thorough it, without any ſenſible change of bulk, figure, &c. as Gems that are ſwallowed down are ſuppoſed to do. For, we know, that ſome Chymiſts make Bullets of the *Regulus* of Antimony (which we alſo have made, and obſerv'd ſomething odd about them) which they call *Pilulæ perpetuæ*, becauſe when they have performed their operation in the Body;

and

and have been ejected with the Excrements, they are by ſome more thrifty than cleanly perſons, waſhed and employ'd again and again to the former purpoſes. Nor do we know, what Analogie there may be between ſome Juices in the Body, and ſome of the Mineral ſubſtances that impregnate Gems with their Virtues.

For, though the *Oculus mundi* be reckon'd by Claſſic Authors among the rare Gems, (as indeed good ones may be juſtly accounted Rarities;) yet if one of the beſt ſort be but a while kept in common Water, it will, as Experience aſſures me, receive an alteration obvious to the Eye. I might here alledge the concurrent Authority of many, and the common Practice of moſt Phyſitians, who in their publick Diſpenſatories as well as private Preſcriptions, ordain the Fragments of precious Stones to be taken inwardly, upon the ſcore of the Cordial and other Virtues they aſcribe to them. But I ſhall rather make uſe of leſs queſtion'd Arguments, and without inſiſting on the manifeſt operation, that

that the Juices of the Body, have not only on the Chalibeat preparations, where the Metal is presum'd to be open'd, but upon crude Steel it self; or urging the Examples of *Lazarus Vitriolax*, or the devourers of Stones, as being rare ἀδυναμίαι; I shall proceed to acquaint you, that with a faint Liquor, distill'd from a Vegetable substance, as temperately qualified and as plentifully eaten as Bread, I have obtain'd, and that without Heat, from divers hard Bodies, and amongst them from a transparent sort of Gems, a manifest Tincture. And whether some Juices of the Body, assisted by the Natural Heat of it, may not, in reference to *some* Gems, serve for extracting *Menstruums*, though it may well be, more then either I or the Objectors certainly know, yet the Instance, I come from alledging, favours our *Hypothesis* more than theirs.

And even the Natural Heat of a human Stomach, nay perhaps the outward parts of the Body, may be able, though not to digest precious Stones, yet to solicite out some of their Virtues; since I

am

am ſure it makes a ſenſible alteration in the hardeſt ſort of them. For I have a Diamond, whoſe Electrical faculty may be excited not only by rubbing, but, without it, by a languid degree of adventitious heat. And I have had in my keeping a Diamond, which by Water, made a little more than Luke-warm, I could bring to ſhine in the dark.

Object. If it be further alledged, that, though ſome Virtues may be conceded to Gems upon the account of the Minerals that impregnate them, yet it will be no way likely, that their Virtues ſhould be ſo Various and Great, as even the modeſter ſort of Authors pretend. If this, I ſay, be alledged, I ſhall readily acknowledge, that I do not think others or my ſelf obliged to believe all the ſtrange things, that even ſome Learned Writers do ſometimes aſcribe to Gems: And if any man will think, that ſome of them are fabulous, and more of them Hyperbolical, he may ſooner find me his Aſſociate than his Adverſary in that point. For the Rarity of tranſparent Gems, their Luſtre, and the great Value,

which

which their Scarceneſs and mens Folly ſets upon them, imboldens ſome to *ſay*, and inclines others to believe, that ſuch rare and noble Productions of Nature muſt be endowed with proportionable, and conſequently with extraordinary Qualities.

But this being freely granted, I anſwer to the Objection; *Firſt*, that 'tis not improbable, that there may be in the Earth a much greater Variety of Minerals diſſoluble by the ſubterraneal Menſtruums, and capable of concoagulation with Petreſcent Juices, then Authors have yet taken notice of: To which conjecture divers ſubterraneal productions, that I have met with, doe ſtrongly incline me. And from the *number* and *various mixtures* of theſe may proceed not only a great Variety of operative particles in precious Stones, but a high degree of Energy in ſome of them.

And *next* I conſider, that the Efficacy of thoſe Mineral Tinctures or Solutions, that are already known to us and may be concoagulated with the

Petreſcent Juice, may be reaſonably preſum'd to be much greater in ſome Gems, whereof they became Ingredients, whil'ſt they were (as Chymiſts ſpeak) *in ſolutis principiis*, than may be expected in our Shops or Laboratories from the vulgar Solutions of the ſame Metals or Minerals, after they have by vehement Fires been reduced into Gold or Silver, or Lead, or Antimony, &c. For, whereas in theſe vehement Fuſions, requiſite to bring Metalline or other Ores into ſuch ſubſtances, the volatile and ſpirituous parts are wont to be driven away, and the remaining Body becomes more hard and compact, and has his Virtues as it were locked up: In the ſtate of Fluidity thoſe ſubtle and efficacious parts are preſerved, and united to the other Ingredients of the Gems, whence ſome Emanations of them may be eaſily enough drawn out: As in the inſtance I not long ſince mentioned, of the eaſie eduction of ſtrongly ſented Steams from Pibbles ſo hard, that I found them more diſpoſed to ſtrike Fire, than Flints themſelves, that are uſed

uſed in Guns. And from the greater or leſs plenty, and natural activity of the impregnating particles in this or that Gem, may problably be deduced the difference in Colour of ſome, and in Virtue of other Stones of the ſame denomination: Of which we have in a Learned Writer or two, eminent Examples given us, of the great Virtue of ſome, and the inefficacy of other, that Experience has diſcovered, among thoſe Stones that go under the Title of *Lapis Nephriticus*. For, though they be not properly tranſparent Gems; yet the Analogy betwixt them and thoſe that are, ſeems ſufficient to warrant the mentioning of them on this occaſion. See *Unzerus de Nephritide.*

And here we may ſubjoin two things, in favour of both the foregoing anſwers: the *Firſt*, that for ought we know, the Petreſcent Juices themſelves may have all that is requiſite to make them ſuch, and yet have diſtinct Natures, and be indowed with peculiar qualities, abſtracting from thoſe which they acquire upon the ſcore of their coalitions with adven-

titious Liquors. This I cannot stay to make probable by the differences I have observed in Petrescent fluids, and therefore I hasten to the Second.

The next thing which I would represent, is, that having observed Petrific Liquors or Spirits to pervade and give a high degree of hardness to bodies, that chanced to lie within their reach, though one would have thought them sufficiently indispos'd to receive such an induration; I see no absurdity in supposing, that sometimes such a Liquor may invade, permeate and subdue transparent Minerals, abounding in Saline, Sulphureous, and Bituminous particles; which consequently being duly excited, may be made to emit their more subtle and more active parts. And as I have cause to think, that subterraneal Fires and *Menstruums* do divers times make various compositions and decompositions in the Earth, (as 'twere not hard for me to shew, if I had leisure;) so 'tis not impossible, but that the Spirit, we have been speaking of, supervening, may mingle it self with such Bodies and petrifie

trifie them together with it ſelf into Gems. On which occaſion, I remember, that I have had Salt, made by nature in the bowels of the Earth, juſt like that which Chymiſts compound by Art on the ſurface of it. And I have ſometimes made by an eaſie operation and a moderate degree of Fire a certain compoſition of *volatile particles* of Salt and Sulphurs (ſome of which I have yet by me) which after diſtillation did in a fluid *Medium* ſhoot into Cryſtals tranſparent, and more curiouſly figured than I have ſeen divers natural Gems to be. So that, if either beneath or upon the ſurface of the Earth, ſuch kind of ſubſtance happen to be pervaded and ſubdued, by a clear petrifying Liquor; we may well preſume that the reſulting concretions may be indued with Qualities, as well uncommon for the Kind, as conſiderable for the degree.

Objection. If it be yet objected, that it is very unlikely, that Gems ſhould part with any Effluvia or portions of themſelves, ſince they loſe not of their weight, and ſome of them are very

little heavier than Cryſtal it ſelf, and conſequently are not like to have much adventitious ſubſtance to part with: I might leave the anſwering of one part of the Objection to Phyſitians and Chymiſts, who teach, that the Antimonial Glaſs and Cup imbue Wine and other Liquors with a ſtrong emetic quality without any ſenſible loſs of weight. But having elſewhere ſpoken of thoſe things; I ſhall rather here demand, whether the Objectors have tryed the truth of what their Argument ſuppoſes by any way ſufficiently accurate? For I much doubt, that that has neither been attempted, nor would be found eaſie to be performed. And till due tryal be made, let me repreſent, that though they will not allow common Water to be a *Menſtruum* fit to draw any thing with from ſuch a Body as Mercury, which is wont to mock the Chymiſts *Aqua Fortis* and *Aqua Regis*; yet both *Helmont* and others inform us, that Mercury kept for a day or two in common Water, or boiled a while in it, though it be taken out without any ſen-

ſenſible diminution of weight or bulk, will have imbued a conſiderable quantity of Water with a Virtue of killing Worms; for which purpoſe 'tis much uſed, and often with good ſucceſs in a great Hoſpital in *London*, as the Chief Phyſitian of it (a very judicious and experienced man,) has more than once informed me.

And as for the lightneſs, that is objected againſt ſome Gems, beſides that it may ſafely be granted, that *cæteris paribus* ſuch may have fewer or more languid Virtues than others of the ſame kind; it may alſo be anſwered, that the adventitious ſubſtance that impregnates the Petreſcent Juice, may be of ſo ſmall ſpecific gravity, as not to make the Gem at all heavier in *ſpecie* than Cryſtal it ſelf. For this, (as we have formerly obſerved,) being about two times and a half heavier than common Water of the ſame bulk, I have hydroſtatically found, that divers Salts and ſome other Mineral ſubſtances are of leſs ſpecific gravity; and conſequently, if they were concoagulated with the Petreſcent

Juice that hardens into Crystal, need not increase the ponderousness of it, and yet may imbue it with considerable Vertues: Nor is it necessary (to add that *in transitu* on this occasion) that, not to alter even the colourlesness of Crystal or the colour of another Gem, the adventitious substance should be purely Saline: For I have divers times made Bodies, which, though transparent and colourless like Crystal, and sometimes curiously and regularly figur'd, were yet of a compounded Nature, and particularly abounded with an easily separable and strongly sented Sulphur. But to give yet a farther and more direct answer to the Objection; I shall add, that though, when a Gem has much more specific gravity then Crystal, or will suffer an adventitious Mineral to be separated from it, 'tis a very probable Argument, that the Petrescent Juice is that Body compounded with an adventitious substance; yet it will not necessarily follow, that, when neither of these Signes appear, the Gem is quite devoid of any such substance. For,

(according

(according to what I elſewhere declare,) the Petreſcent Liquor, it mainly conſiſts of, may be impregnated not with the groſſer ſubſtance, but with the finer and more ſpirituous part of the Mineral, without having the ſpecific gravity ſenſibly increas'd. Of which I remember I ſhew'd a notable Inſtance to ſome curious perſons, at a Mineral Spring, which many were then drinking of by the Adviſe of Learned Phyſitians for ſeveral Diſeaſes. For though this Water both by it's Inky taſte, by it's blacking the Excrements of thoſe that drank it, and by other Signs appear'd to participate richly enough of Iron; yet the ferruginous particles, it abounded with, were ſo light and ſpirituous, that not only they would, as I tryed, be eaſily loſt, if the Liquor were kept too negligently ſtopt; but when I came whilſt the Spirits were yet there, (it being but newly taken from the Spring it ſelf) to examine it hydroſtatically with very good Scales and much diligence, I convinc'd the *Virtuoſi* that aſſiſted, that this ferruginous Water was very little, if at all,

all, heavier *in ſpecie* than other Water, which was brought as common Water to be compared with it, and examin'd with the ſame Scales and after the ſame manner.

And now, if you recall to mind what I have elſewhere ſaid partly of the Atmoſphers of ſolid Bodies, and partly of the great Efficacy of Effluviums; I hope, you will not think it abſurd to conjecture, both that ſome precious Stones may have Medical Virtues, and that divers of theſe may be aſcribed to the Mineral ſubſtances, whereof they participate or conſiſt; and eſpecially to thoſe, which are beſt fitted to exert their powers by the copious Effluxions of their more agile and ſubtle parts.

And by this time it may be ſeaſonable to tell you, that though, what I have hitherto diſcours'd do chiefly belong to tranſparent Gems; yet divers of the things already deliver'd may, with no great alteration, be applied to opacous Gems: of which I ſhall ſpeak much more briefly, not only for the reaſon juſt now given, but becauſe, if we have

ſhewn

ſhewn (as I hope we have) that even Diaphanous Gems may be indowed with Virtues by the Mineral ſubſtances they contain or are in part made up of; the Arguments will hold more ſtrongly as to opacous Gems: both becauſe theſe are for the moſt part much leſs hard than the others, and becauſe 'tis far more eaſie to ſhew by their ſpecific gravity, and the compoundedneſs of divers of them, that the dark ones, than 'tis that the clear ones, may partly, and ſometimes plentifully, conſiſt of Mineral ſubſtances, imbodyed with, and hardned by Petreſcent Juices or Petrific Spirits.

In favour of this Doctrine, I ſhall endeavour in the firſt place to ſhew, that what has been deliver'd is *poſſible*; and afterwards ſet down ſome particulars to make it *very probable*.

The firſt part of my Taſk might be eaſily performed, or perhaps would be needleſs, if I were ſure, you had no need to be told of any thing I have written about *Lapideſcent Juices*. But for greater ſecurity I ſhall in this place briefly

briefly intimate, that among the Kinds of thoſe Liquors, I have obſerved a ſort that is of ſo fine a ſubſtance, and yet of ſo Petrifying a Virtue, that it will penetrate and petrifie Bodies of very differing Kindes, and yet ſcarce, if at all, viſibly increaſe their bulk, or change their ſhape or colour. To which purpoſe, I remember, that I have ſeen divers Animal and Vegetable ſubſtances ſo petrified, as ſcarce at all to be taken notice of, by their appearance, to have been alter'd by the operation of the Petreſcent Liquor. I have with pleaſure ſeen a thin Cream-Cheeſe turn'd into Stone, where the Size, Shape, and Colour even of the Wrinkles, and the blewiſh Mold (which it ſeems it began to have when the Liquor invaded it) were ſo well preſerv'd, that an hungry man would not have ſcrupled to have fallen upon it for a good Bit. And as for the hardneſs, that this Petreſcent Juice can give to the Body that it penetrates, I ſhall now only remind you of what I lately told you: That I have had, (and I think yet have in another place)

a pretty

a pretty quantity of Wood petrified in *England*, which retaining its former figure, and grain, and ſcarce at all viſibly increas'd in bulk, was ſo very hard, that I could make Impreſſions with it upon Iron, and Glaſs it ſelf, and make it ſtrike Fire like an excellent Flint. To which I ſhall here add, that the ſtony parts did not ſuffer the Wood, which they had penetrated, to be reduced in the Fire, either to Aſhes or Charcoal. And I have by me a lump of Mineral Subſtances, wherein a Petreſcent Liquor, that fills the large intervalls between them, is tranſparent enough, and harder than moſt Stones, as far as we could gueſs by ſome tryal of it made by a skilful Ingraver of Gems.

And to theſe inſtances might be added many others, if it did not by theſe few ſufficiently appear, that Petrifick Agents may inſinuate themſelves into the pores of various Bodies, and turn them into Stone, without otherwiſe deſtroying their priſtine Nature, or ſo much as their former Figure.

Wherefore having in general ſhewn

our

our *Hypothesis* to be *possible*, we may now descend to four or five particular Arguments, that 'tis hoped may help to render it very *probable*. And these I shall fetch *partly* from the great specific gravity of divers opacous and medicinal Stones; *partly* from the fitness of our *Hypothesis* to render a reason of divers *Phænomena* relating thereunto, some of them scarce at all, and others much less probably to be accounted for without it; *partly* from the Metalline substances to be manifestly separated or obtained from the Stones we are treating of; and *partly* from the Nature of the Bodies whereof Medicinal Stones seem to be compounded.

Arg. I. That the specific gravity of divers opacous Stones, whereunto Medicinal properties are ascribed, is very considerable, is a Truth, which, if those that have writ ten of such concretions had been vers'd in Hydrostaticks, & had had the curiosity to examine them that way, they might have easily discover'd; as will quickly appear by particular Examples: Before the mention whereof,

of, it will be fit for me take notice to you, that considering with my self that white Marble is generally allowed to be a pure and solid Stone, and upon the score of its whiteness is likelier than most others to be free from Mineral mixtures, I thought, I might at least as well pitch upon that as on any other for the standard of the specifick gravity of opacous Stones, as they are meerly such. And accordingly having weigh'd a piece of white Marble in Air and Water, I found it to be in weight to an equal bulk of that Liquor very near $2\frac{13}{100}$ to 1, or, (that the proportion with very little errour may be the better remembred,) as two and seven tenths to one. And to make trial in a Stone uncoloured, but, because harder, suppos'd to be of a closer Texture, we examin'd a fine white Pible, which we found to be to an equal magnitude of Water as two and above six Tenths to one. This being determin'd, 'twas not difficult for me to think, *both* that divers Bodies, that commonly past for *meer* Stones, are more ponderous than white Marble of the

the ſame bulk; and that, if there were any ſuch great ſurpluſage of ſpecific weight, as I gheſt, many will be found to have above that of Marble, it might proceed from ſome Metalline Body, though not viſibly, yet really, and perhaps plentifully mingled with the Petreſcent matter of theſe Stones. The later part of this Conjecture will hereafter be confirm'd in the *third* Argument; which makes it unneceſſary for me to give you now of the former more than a few inſtances: which I ſhall ſoon diſpatch by telling you, that I quickly found by weighing the following Minerals, firſt in the Air and then in the Water, that a *Blood-ſtone* (bought at the Druggiſt) was in weight to Water of the ſame bulk as $5\frac{7}{10}$ to 1; The *Load-ſtone*, I then tried, (for all are not equally heavy *in ſpecie*) as 4 and $\frac{8}{10}$ths, to 1; *Lapis Calaminaris*, us'd for Rheums in the Eyes, and to turn Copper into Braſs, as $4\frac{7}{10}$ to one; *Lapis Tutiæ*, as they call it, which is alſo much imploy'd in Rheumatick Eyes, as very near 5 to 1.

But

But here I muſt advertiſe you, that I have not found the proportion of each of theſe bodies and water to be any thing near conſtantly the ſame, but ſometimes to differ very much in particular Stones of the ſame kind; which agrees very well with our *Hypotheſis*. For, according to that, thoſe particular Stones, that happen to partake more plentifully of Mineral ſubſtances heavier *in ſpecie* than Stone as ſuch needs to be, ought to be more ponderous than others of the ſame kind that are not ſo qualified: I ſaid, *heavier in ſpecie than a Stone, as ſuch need to be*, becauſe there are ſubſtances that are reckon'd among Minerals, and are capable of endowing the ſtony matter, wherewith they are coagulated, with Medical Virtues, and yet thoſe ſubſtances may make the Stone or aggregate, whereof they are made, not to be heavier but lighter *in ſpecie*. From Jet, which in ſome parts of Europe being found in Quarries of Mines is indeed a foſſile, which is wont to be reckon'd among Stones, and by many worn as

a Gem; I obtain'd no inconsiderable proportion of oil; and having weigh'd choice Jet it self in water, I found it to be bulk for bulk to that Liquor but as $1\frac{22}{100}$ to 1. And there are some other fossils, hard as Stone and pollishable as Marble, from which I have by distillation obtain'd two kinds of Oil, whereof one was lighter than common water; which shews, that even bituminous and light substances may be ingredients of a Stone: And that Salts, which are most of them less heavy *in specie* than white Marble, may plentifully concurr to the making up of Stones, I shall have occasion to manifest at the close of this Discourse by those Stones, whereof we in *England* use to make *Vitriol.* The foregoing Reflection I have here touched upon, because I would intimate to you, that Stones that are lighter *in specie* than white Marble may be compounded of fossils whence they may derive peculiar Qualities, at the same time when I tell you that in my opinion such Stones as are considerably more heavy *in specie* than Marble may afford

afford us a ſtrong preſumption of their owing their gravity to the mixture of Metalline or Mineral ſubſtances. And this may ſuffice for our firſt Argument.

Arg. II. The next ſhall be taken from the conſideration of ſome *Phænomena*, (relating to Medicinal Stones) which agree very well with our *Hypotheſis*, and will ſcarcely be very well explicated without it.

And 1. As to *Tranſparent* Gems themſelves, I have learn'd by inquiry of Travellers, that have viſited thoſe parts of the *Eaſt Indies*, where they grow, that ſometimes one ſort of Gems, ſometimes another, and ſometimes alſo Diamonds themſelves are found included in the Rocks where they are digg'd for, or in the midſt of hard looſe Stones, which muſt be broken in pieces, to take out the Diamond or other incloſed Gem: Which *Phænomenon* will be hard to be accounted for, unleſs by our *Hypotheſis*; according to which it may rationally be ſuppoſed, that the Gem was firſt formed either in Earth or ſome other ſoft and eaſily permeable

substance, which being afterwards pervaded by some Petrific juice or Spirit, was turn'd into Rock or loose Stones, according as the Earth and other ambient matter chanc'd to be an intire and coherent mass, or divided into clods & other portions. And I remember, that the Governour of an *American* Colony, having sent me among other Rarities, digg'd up in his Countrey, an odd kind of Mineral, that seem'd more ponderous than at first sight it promis'd, I had the curiosity to break it, and found in it, here and there, several Gems, which by their figuration and some other circumstances were concluded to have been form'd there, before the ambient Mineral had obtain'd the nature it then appear'd to be of. And in *Opacous* stones it may hence happen, that a great lump of Medicinal Earth may be invaded and petrified after the newly mention'd manner; so that it may not be thought incredible, that some of these Medicinal Stones should be very large in comparison of others: As I remember, that an ingenious

nious Phyſitian told me of a Spleen-ſtone, as they call them, in the hands of an acquaintance of his (where I might have ſeen it, if my occaſions had permitted,) amounting to about four-ſcore pound weight. And on this occaſion, I alſo remember that even in a Medicinal Stone, much harder and heavier than Marble, and whereof I have ſeen lumps far greater than I could lift, I remember, I ſay, that having had the curioſity to cauſe a pretty big piece, violently broken off from the maſs whereto it belong'd, to be ſawn aſunder, that I might conſider the internal Textures, as far as 'twas viſible; I found ſeveral empty Cavities of differing ſizes and figures in the ſolid ſubſtance of the Stone, (which I think I have not yet loſt:) which ſeems to argue, that this compact and ponderous Body was made of a ſtony nature by the ſupervening of ſome Petreſcent Liquor or Spirit, upon porous Earth or ſome other conſiſtent ſubſtance. For if it had been a meer Liquor wherein thoſe Cavities muſt have been ſo many aerial bubbles; 'tis

not like that ſome of them ſhould have ſuch irregular ſhapes, and that all ſhould have continued without emerging to the top.

2. Our *Hypotheſis* will alſo help to render a reaſon of what ſeems exceeding difficult to be explicated; namely, How ſome Gems, that ſeem to be intire Stones, are in part of one colour, and in that, which is contiguous to it, of a quite differing: Of which ſort we have the *Sardonix*, and ſome other opacous Gems. And I have obſerv'd the like, though very rarely, in diaphanous ones. For, according to our *Hypotheſis*, it may be ſaid, that a portion of matter, imbued with one of the Tinctures of the parti-colour'd Gem, was firſt form'd, and afterwards, ſome Petreſcent Juice, endowed with another colour, came to ſettle contiguouſly to it, and ſo by accretion made up one Stone with it. I might illuſtrate this by telling you, that though Fire do make a far greater agitation of Bodies melted by it, than need be ſuppoſed in cold Petreſcent Liquors, yet I have

have found in making Artificial Gems, that by ſome miſchance or error in the operation, the Mineral pigment has richly tinged one part of the tranſparent maſs, without at all imparting that colour to the very next part to it; ſo that if I ſhould ſhew one of thoſe I I have yet by me, you would judge it to conſiſt of two differing Gems ſubtlely glewed or faſten'd together, unleſs you ſhould in vain try as others have done, to diſcover by the Eye or otherwiſe ſome naked commiſſure, which may keep thoſe ſo differingly colour'd Bodies from making up one intire maſs.

But let us leave theſe Artificial Gems, and add to what I was ſaying about our Natural Ones, that the Union of parts in theſe Reſulting Stones (if I may ſo call them) I was ſpeaking of before, might be the more perfect, if the ſupervening matter found not the firſt form'd Stone to have attain'd to its full induration: Though, for ought I know, even in this caſe, the appoſition may be ſo cloſe, and the two matters ſo near of

kin, that both may paſs for one Stone, and be poliſh'd both together without any blemiſhing diſcontinuity of ſurface at thoſe parts, where one would expect commiſſures. For I have by me a lump, wherein there plainly appear Stones of colours very different from each other, that were once diſtinct and incoherent; but by ſome petreſcent Liquor have had all their intervals ſo exquiſitely filled up, that neither the touch nor the Artificers Tool, the lump being now ſawen aſunder, diſcovered any Commiſſures; but the whole Maſs bears an uniform Poliſh, and is harder than divers Gems that are worn in Rings, readily enough ſtriking Fire with a ſteel. And to confirm this the more, I ſhall add, that in a place where a prying perſon of my acquaintance lighted on this portion of petrified matter, he found not only other lumps, but divers looſe Stones, that ſeem'd altogether of the ſame nature with thoſe, that by the ſupervention of the Petreſcent Liquor were united into ſtony maſſes. I have alſo had a curious *Agat* ſo form'd, that

it

it seem'd highly probable, that the opacous parts of its matter had been some thin, but not altogether contiguous, Beds of fine Clay, or Earth, lying almost parallel to each other (but not to the *Horizon*,) which by some Petrescent Liquor, that chanc'd to settle there, was reduced to coagulate with it into a partly opacous and partly diaphanous Stone. And of such Clays or Mineral Earths, I have sometimes with pleasure observed more than one or two, which, though distinct and perhaps of differing colours, were so very thin, that the thickness of them all did scarce exceed an inch, nor did they always lie flat or horizontally, but in differing postures both in reference to the *Horizon*, and one an other, and now and then the exterior ones did successively almost surround the interior: And of these thin Couches or Layers of Earth, I remember, I have observ'd a considerable number, within a very small compass of ground. I must not in this place stay to shew, how probable 'tis, that much after the same way may be explicated

cated the production of divers other Gems beſides *Agats*, as *Chalcedonians* and *Jaſpers*, which are for the moſt part opacous, but oftentimes have ſome parts that are not ſo. But I am content, before I go further, to mind you on this occaſion of what I elſewhere deliver, That by purpoſely calcining, without breaking, ſome of theſe Stones, whoſe greater part was diaphanous, I found, that the tranſparent parts turn'd white; and that ſome of the thin Layers or Couches of Mineral Earth had retain'd their colour as well as poſition, and had it much heighten'd; ſo that one of theſe Layers after calcination was of a very rich and permanent Red. And this difference of Colours I obſerv'd not only in Layers, but in the Specks and irregularly ſhap'd Clouds (if I may ſo call them) of other Colours (as Greeniſh, Blewiſh, &c.) I might here add, that I have found ſhining *Marchaſites*, not only in other ſolid Stones, but in Marbles; as alſo Flints themſelves, incloſed in great maſſes of Marble, and likewiſe

likewiſe Wood; in ſtrong Stones imploy'd to build a Wall, and Shells (at leaſt as was judg'd by their ſhapes and ſizes;) in a great maſs of Stone that I met with almoſt on the top of a Hill remote from the Sea, together with divers other ſuch *Phænomena*, which I think may probably be accounted for by our *Hypotheſis* and ſcarce without it. But being willing to diſpatch this Diſcourſe, and unwilling to intrench upon the Diſcourſe of the *Effects of the Petreſcent Juice*, (to which the conſideration of theſe and divers other *Phænomena*, to be met with about the Generation of Stones and petrified Bodies, eſpecially in Wombs or Molds, more properly belongs;) I ſhall in this place only point back to one *Obſervation*, and anſwer one *Objection*; becauſe both of them are pertinent to our preſent Diſcourſe.

The *Obſervation* is this: That even in tranſparent Gems, and which is more, of the ſelf ſame *ſpecies*, I have ſometimes taken notice of ſuch an Aggeneration or Accretion of Stones to one another, as argues their having been

been produc'd at ſeveral times. For proof of this, I need no more than re-
Page, 76, 77, & 78.
ferr you to what I have not long ſince, related about thoſe *Corniſh* Diamonds, wherein ſometimes a leſſer Stone, though Geometrically ſhap'd, was found in good part inclos'd in a greater, as well as in part alſo extant above it. Whence I argued, that the production of this aggregate of two Cryſtalline Bodies was not made all at once, but ſucceſſively, and that the leſſer was firſt form'd, which I ſhall now confirm by this Conſideration. That if the greater Stone had been firſt harden'd, the matter of the leſſer muſt only have exteriourly ſtuck to it, and been as it were imboſt upon it; but could not have made it ſelf in the ſubſtance of the greater a Bed or Mold, eſpecially of ſuch a Geometrical figure as it ſelf had not yet received.

And though this ſucceſſive Generation of the parts of (ſeemingly) intire Gems may appear to you ſomewhat new and ſtrange, yet that its fitneſs and requiſiteneſs to explain the foregoing

Phænomena

Phænomena and others, to be hereafter mentioned, may the more recommend it to you; I ſhall add, that perhaps you may be aſſiſted to conceive, if not invited to admit it by a Mechanical illuſtration. For we ſee in divers Chymical Solutions, as of Salts and other Bodies, that there are certain ſtages or periods of coagulation; ſo that, when ſuch a quantity of the ſuperfluous moiſture is exhal'd, eſpecially upon any conſiderable refrigeration or other favourable circumſtance, thoſe particles that are moſt diſpos'd to coagulation will convene and ſhoot into Cryſtals, after which no more will do ſo, till a farther and more conſiderable evaporation of the water or other *Menſtruum* be made; upon which will enſue a new Cryſtallization of the parts. And I can ſhew you the productions of a metalline, but uncommon Solution, that I ſo made in an appropriated Liquor, that the firſt ſhooting afforded me a Layer or Bed of curiouſly figur'd Cryſtals, and the following, another Layer of fine Cryſtalline Bodies, that have faſten'd themſelves to

to the former, but differ notably from them both in shape and posture. And in this Experiment, the dissolv'd Body was but one, as the *menstruum* but one; but if there be a diversity of nature in the Liquors that make up a *menstruum*, or in the Bodies that are dissolved in it; some of the Corpuscles may convene either a part with those of the same Nature, or mingled with those of a differing Nature; but yet at the same time and so make up Crystals of a compounded Nature, and some of them may convene with homogeneous particles, but at differing times; and so miss of such uniformity as might else appear in their concretions. Which may be illustrated by what I have elsewhere related concerning the Crystallizations of Salt-Peter and Sea-Salt, dissolv'd together in ordinary water; where most commonly grains of Salt of resulting figures are produc'd; and also a considerable part of the Sea-salt coagulates in the form of imperfect Cubes about the bottom, before the nitrous Corpuscles shoot into Crystals of their own

own (almoſt priſmatical) ſhape. And I might further add, that it matters not, whether the ſuperfluous water be waſted by Exhalation, or by being drained by a body fit to ſoak it up; as we have had occaſion to obſerve in accelerating the Cryſtallization of ſome Bodies, where I was not willing to imploy the heat of the fire, by placing, underneath the Solution, dry'd Earth, or ſome other porous and ſoaking body.

With ſome Analogy to ſuch inſtances as theſe, we may conceive, that where there are Petreſcent Liquors, mingled with common water, there may, by divers accidents, and particularly an hot Summer, a ſufficient diſcharge be made of the ſuperfluous moiſture, to make the more diſpoſed parts of the Petreſcent Liquor to coagulate, and afterwards the coagulation may be ſuſpended, either by the ſupervening of a colder ſeaſon, as Winter; or even in Summer it ſelf, by a plentiful rain, or the effect of it, a Land-flood, which might check the progreſs of coalitions by overmuch diluteing the Liquor, that might

might elſe have turn'd into Stone. Not to mention, that trial hath aſſured me, that there are Bodies, and thoſe of very differing kinds, which will in tract of time, eſpecially if their coalition be further'd by cold weather, coagulate, after they have long remained in a fluid form, though the water or other *menſtruum*, by being inclos'd in ſtopt Glaſſes, be kept from waſting. And ſince the Earth harbors differing kinds of theſe Liquors (as I have elſewhere ſhewn) and divers of them may be copiouſly impregnated, ſome of them with one ſort of Mineral, and ſome with another; we may conceive, that they may have diſtinct periods for their reſpective coalitions, and yet may ſtick cloſe to one another; in regard that, though in our Chymical Cryſtallizations the Artiſts are wont to take out of the veſſel what ſhoots the firſt time, before they make a freſh exhalation of the water for a new Cryſtallization, and by this means have the coagulated Bodies, that they obtain at one time, more uniformly ſhap'd; yet in the hollow Receptacles, that the Earth

Earth affords to Petrescent Liquors, the Vessels continuing the same from first to last; the Uniformity of the Bodies produc'd by coalitions made at several times must be less regular, and the *manifest* accretions or aggregates of coalescent Bodies must in all likelihood be more frequent. And accordingly having suffer'd the exhaling of some Liquors to be continued in the same Vessel, I had coalitions of very differing Bodies at the bottom.

What I was not long since saying, makes me remember, that in order to a satisfaction (which the Event gave me) of the conjectures I had about the successive concretions of some solid Firestones, that were not suspected to be other than intire and uniform masses, I caus'd two or three that I thought likely and of very different sizes and shapes, and brought from distant places, to be warily broken: Which Tryal gave me the pleasure of observing, that the internal Texture of the least of these Minerals, which was almost spherical, was very differing from that of the more

internal part of the substance of the Stone. And that in the other and greatest Mineral there was a little globulous Stone, that manifestly was not of the same piece with the invironing mass, differing from it not only in Texture, but here and there by a discernable Commissure: though in most places their Adhæsion was so strict, that we could not make any separation of the two Minerals by the help of this Commissure. The greatest part of this double Fire-stone I keep by me, and shall say nothing of what I further observ'd in it, having mention'd what I said already but upon the by.

I might add, that in some Circumstances, even in those Vessels, and therefore without any manifest exhalation of the water or other *Menstruum*, and sometimes where the dissolv'd Body was homogeneous, I have in process of time had coagulations, where the last form'd Crystals seem'd plainly to have been generated by way of accretion to the first.

Difficulty. Having now done with my

my *Obſervation*, I ſhall endeavour to clear a grand Difficulty, which I foreſee may be *objected* againſt our *Hypotheſis*, namely, That theſe *Aggenerations* (if I may ſo call them) of Medicinal and other Stones are ſometimes found in places, where there are no petrifying Springs, and perhaps no Springs or other Waters at all, nay little or nothing but Quarries or other maſſes of Stone.

But to this I anſwer, *Firſt*, that if we admit of the Relations, that I elſewhere mention out of approved Authors concerning Men and Beaſts turn'd into Stone by a petrifying Spirit, that ſuddenly invaded them, it will not be abſolutely neceſſary that there ſhould be any Petreſcent Springs or other like water to produce ſuch Minerals, as we are now diſcourſing of.

Secondly, for ought has yet been ſhewn to the contrary, we may ſuppoſe that Rain-water does ſometimes bring along with it ſuch petrifying particles as may ſerve our turn. In confirmation whereof I ſhall add, that having of a learned and judicious perſon inquired

after divers particulars relating to a famous Bath, by him viſited in *Hungary*, whoſe Water abounds very much with Petreſcent particles, over which there is very high Building erected, I learn'd by his anſwers, among other remarkable things, that to the Roof or upper part of this tall Structure there were faſtened many long ſtony concretions, (like thoſe wont to be imploy'd to adorn *Groto's*;) which he affirmed to be from time to time generated there, not, as I at firſt ſuſpected, by the daſhing up of any drops of water; (which he averr'd could not reach any thing near ſo high,) but by the copious petrific ſteams, that being there checked in their aſcent, did, according to their natural propenſity, coagulate into Stone. Whether this Relation may warrant me to gueſs, that in ſome places Stones may be generated, without the help either of Rain or Springs, by the aſcent of Petrific particles in the form of exhalations from ſome lower parts of the Earth; which exhalations, ſuffering the lighter ſteams that accompanied them to exhale, may operate

operate upon ſome diſpoſed materials that they find in their way, and turn them into Stone: whether, I ſay, this narrative may well ſuggeſt this conjecture, I ſhall not now ſtay to examine, though the Earthy and ſometimes Sulphureous ſediments that have been obſerv'd at the bottom of Rain-waters, ſuffer'd to ſettle in clean veſſels, may ſeem to favour it; and though alſo I might illuſtrate it by what I obſerv'd in a Bottle of diſtill'd Liquor, whereof no part would naturally aſcend in a dry form: for having kept this Viol well ſtop'd in a ſafe and quiet place for a year or two, I obſerv'd that the aſcending ſteams had quite pervaded the Cork, and had formed at the top of it numerous whitiſh *ſtiriæ*, ſlender, but of a length that ſurprized me.

Thirdly, there is no neceſſitie, that in all ſoils, where petrific waters are to be met with, there ſhould be petrifying Springs, at leaſt above ground. For I have cauſed to be digg'd ſtore of figur'd and tranſparent Stones in a certain Earth, that lay upon the upper part

of a Rock, and ſeem'd to be a very dry Soil: Perhaps you will allow me to tell you, that I have by pouring a ſolution of ſtony *ſtiriæ*, made with Spirit of *Verdigreaſe*, on a convenient quantitie of *Bolus Armenus*, and ſuffering the ſoft mixture to remain in a Glaſs in the open Air, till the ſuperfluous moiſture was exhal'd; I have, I ſay, by this means imitated in a little, what I have been now relating, and found ſmall but unting'd and figur'd Cryſtals diſperſed through the little Cavities of the Red Earth. But 'twill be more conſiderable to our preſent purpſe to add, that the faireſt and hardeſt petrifying Wood, that I ever had or tryed, was taken up by an Ingenious perſon I imployed in a Plot of Sandy ground, where he could not find any petrifying or ſo much as any other Spring. To which I know not whether I ſhould add, that ſuppoſing the ground to have been once moiſtened with a Lapideſcent Liquor, whether brought thither by Springs, or any other way; one may in our *Hypotheſis* well enough account for this difficult *Phæno-*

menon,

menon, that now and then, not only in the ſurface of the ground, and perhaps upon Rocks themſelves there are found Aggregates of figur'd Stones, that ſeem to grow upwards, as it were from a Root; which much puzzle men to know how they came there, and may incline them to their opinion, who aſcribe Vegetations to Stones. But to this may be anſwered, that many of the Concretions, we are ſpeaking of, may have been formed in wombs that lay, though not deep, yet under ground, or in ſhallow cavities in the ſurface of it, and that, after their formation, the looſer Earth that ſurrounded them, may have been waſhed off by Rains, blown off by Winds, or otherwiſe remov'd, leaving behind them theſe Stones that adher'd firmly to a ſolid Body. Beſides, if I had time, I think it were very poſſible for me to ſhew, that ſtony Concretions might be produc'd by the Mechanical action of the Air upon the ſtony particles that ſucceſſively apply themſelves to the matter, that firſt begins to coagulate, when they are ready

to be forſaken by the moiſture that accompanied thoſe particles, and was neceſſary to their due application to the caſual rudiments (which paſs for Roots) in imitation whereof I have more than once obtained both from ſaline and ſtony Solutions, dry tufts of prettily figur'd, and diaphanous or white, but very ſlender, *ſtiriæ*, (if I may ſo call them) that ſeemed to grow out of the ſolid Glaſs, and made men wonder how they came thither, no Water or other Liquor appearing near them.

Fourthly, It may very well happen, that the Petreſcent Liquor may be ſo mingled and dilated with ordinary water, as not to be diſtinguiſhed from it by the generality of men, nor to be capable of diſcloſing it-ſelf by its effects, till either by the copious exhalation of the common water, or by ſome peculiar advantages, it has to operate upon Bodies, it has opportunity to diſcover it ſelf. On which occaſion I ſhall add, that there is a Lake in the North of *Ireland*, wherein I could never hear but that Fiſhes lived as well as in other Lakes,

Lakes, and yet there are ſome Rocks near the bottom of it, to which there faſten themſelves divers maſſes and other pieces of a finely figured ſubſtance, and tranſparent as Cryſtal; of which an eminent perſon, the chief Owner of the Lake, preſented me with ſome, and promiſed me more. Now if we ſuppoſe, that either by Springs of Petreſcent water, or by Rains, or by ſubterraneal ſteams, or otherwiſe, waters, reſting in any hollow place, though upon the top of Rocks and Mountains, ſhall be ſufficiently impregnated with Petrific particles; and that afterwards in proceſs of time the meerly aqueous parts ſhall be, by degrees, by the heat of the Sun, the ſoaking of the grounds, the winds, or the continual action of the Air, brought to exhale away in the form of Vapors, the Petrific particles, which are not ſo volatile, will turn the Soil beneath them and on the ſides of them, as far as the Sphere of their activity reaches, into Stone harder or ſofter, of this or that kind, according to the particular nature of the Petreſcent

trescent Liquors, and the Structure and other dispositions of the Soil they invade: In which Soil, if there chance to be lodged Bodies heterogeneous to it, whether vegetable substances, as Roots, pieces of Wood, Gums, &c. or the whole Bodies of Animals, as Toads, Frogs, Serpents, Fishes, &c. or their parts, as Shells, Bones, &c. or Minerals of an open Texture, as Boles, unripe Ores; or else Gems or Stones of another kind already form'd; any of these things or any other that shall chance to be lodged there, must be found either petrified or inclosed in Stone, when this changed and hardened Soil shall come to be broken up. Nor is it at all necessary, that this petrefaction of the extraneous Bodies, and of the Soil or Bed, be made at once: For, it may well be made successively at several times, according as some parts of the Petrescent Juice happen to be more copious and penetrant, and consequently more fit to be soaked in further than other. For, as the porousness happens to be greater in one part of the Soil than

than in another; or as the Texture and diſpoſition of particular Bodies, lodged in the Earth, gives advantage to the Petrific particles to work on ſome of them ſooner, or in a differing manner than in others; ſo the Induration of the pervaded matters may be very unequally made in point of time, as well as in other circumſtances. So that (to omit many other things explicable by it) we may, from what hath been already deliver'd, conceive, how it may happen, that Medical Stones of very differing Colours, Conſiſtencies, and Operations (of which I have ſeveral by me, that I had from the ſame Mineral maſs,) may be generated and ſeem intire Bodies, though (as in ſome that I found,) the difference is ſo great, that one part of the Medical Stone is dark, heavy, and opacous, and the other much lighter, tranſparent, and quite otherwiſe colour'd. And upon the ſame Principle may be explained, what I lately mentioned to you about the finding of Diamonds incloſed in looſe Stones and even in Rocks; of which we have credible Teſtimony.

Teſtimony: which ſeems not more ſtrange to me than a Stone, which I have by me, which being a kind of Pible, contains in it a perfectly ſhap'd Serpent, coild up, but without a head, which appears to have been formed before the Stone, in regard that in the upper and lower parts of the ſolid Stone there are cavities left, which together make up one Cavitie, juſt of the ſize and ſhape of the contained body; to which as it was eaſie for the matter of the Stone, whilſt 'twas yet a ſoft body, to accommodate it ſelf exactly; ſo 'tis ſcarſe conceivable, how, if the Pible had been firſt form'd, the incloſed *animal*, if it were one, or the matter whereof the ſeeming animal afterwards was formed, ſhould not only get in, but find a cavity ſo curiouſly ſhap'd and ſo fitted to its bulk. And that this variety was produced at ſeveral times, might be further argued from this, that the ſeeming Serpent is plainly of another and clearer kind of Stone than that of the Mold, that incompaſſes it; and of the Mold it ſelf, one part, contiguous to the included

included body, is whitiſh, and abounds in ſhining grains or flakes; in both which, it differs from the other and far greater part. And now it will be time to haſten to the

Fifth conſideration, which is, that for ought we know, in thoſe very places, where now there is nothing to be ſeen but looſe Stones, and perhaps beds of Stone themſelves, that in thoſe very places (I ſay) there may in times paſt have been Petreſcent Liquors, whether ſtagnant or running. For, I * elſewhere ſhew, (to an other purpoſe) that Earthquakes, Inundations of Seas and Rivers, ſinkings of ground, incroachments of the Land on the Water, fiery Eruptions and other ſuch Accidents, (ſome related by Authentick Authors, and others happening in our own times, in places, ſome of which I had the curioſitie to ſee,) have among other odd effects been able to dry or choak up Pools and Lakes, and to ſtop and quite divert the courſe not only of Springs, but

* In an *Examen* of an Experiment urged for the Magnetiſm of the Earth.

but of Rivers, ſo as to leave no foot-ſteps of them, where they plentifully flow'd before. Upon the ſcore of which tranſpoſitions of notable quantities of terreſtrial matter and other great changes of the ſtructure and diſpoſition of the Soil in divers places, it may well be ſuſpected, that the ſtony Wombs or Molds, wherein the above mentioned Bodies were found, were heretofore at ſometime or other, of a muddy or earthy Nature, and were receptacles of Petreſcent Liquors, which at ſeveral times turn'd the whole maſs of the Soil into Stone, before the Springs or other Waters, containing the Petrific Liquors or Spirits, were quite conſumed, or had their courſe altogether diverted. But though I could ſay much more to confirm and apply this, and the preceding conſiderations; yet having ſpent ſo much of my time already, I ſhall not only leave all that unſaid, but, to make ſome amends for having ſtaid ſo long in clearing this difficulty, I ſhall do little more than name the two remaining Arguments.

Arg. III.

Arg. III. It agrees very well with what we were formerly saying (in the first Argument) about the great specific gravity of such as the newly mention'd Stones, in comparison of that of white Marble or transparent Pibles, that it should be possible, out of those Minerals to extract some of that substance, whether Metalline or of kin to it, upon whose account I told you I supposed them to be so ponderous. And accordingly we have by appropriated *Menstruums* obtained, from the forementioned Bodies, (and not from those only,) Solutions or Tinctures, which, besides that, by their colour or taste, they discover themselves, did, upon their being dropt upon a Solution of Galls or some other convenient Liquor, or upon their being examin'd by other proper ways, produce such changes of colour or such determinate *Phænomena*, as argued them to abound with Metalline or Mineral particles, (which, for the most part of them I observ'd to be of a Vitriolate nature;) so I found, that the Solution of a *Blood-stone*, which tasted

tasted very rough upon the Tongue, would with the infusion of Galls make an Inky mixture; and the like would also be made with Load-stone, Emery, Marchasites, &c. open'd with corrosive *Menstruums*. But the Solution of *Lapis Calaminaris*, which was of a golden colour, did not operate like the rest on the infusion of Galls; but yet by its tast, as well as colour, sufficiently discovered it self to have copiously impregnated the *Menstruum*. And now the mention of *Lapis Calaminaris* minds me to take thence an instance of what I lately intimated, that there may be other ways, besides that of dissolutions in proper *Menstruums*, to shew, that some Medicinal Stones participate of Metalline and Mineral substances. For it is by melting *Lapis Calaminaris* with Copper, and keeping them together for a competent while in fusion, that Brass is made; wherein the red colour of the Copper is changed into a golden one, and the absolute weight (for I speak not of the specific gravity) considerably increased. Nor

is this the only Mineral Stone, from which I have, by a way quite differing from those I have yet mentioned, namely with running Mercury, obtained a Metalline substance. And though native *Cinaber*, used by eminent Physitians both inwardly and outwardly, be looked upon by the Vulgar as only a red Stone; yet 'tis known, in the Quick-Silver Mines of *Friuli*, and some other places where it abounds, that it is a Mercurial Ore, whence by vehement fires they distill running Mercury, which we by moderate ones have sometimes done.

But here perhaps it may not be improper to tell you, that though, before any admonition given men of the expediency of examining stones Hydrostatically, I could not receive from others, yet I made against my self the following Objection, That there are some Stones, to which useful Qualities are ascribed, which are either not at all heavier *in specie* than is requisite for a Stone, as such, to be; or so little heavier, that 'tis no way likely, that Metals or any

ſuch ponderous Minerals ſhould contribute either to their Productions or their Virtues.

In anſwer whereunto I thought it may be ſaid in the firſt place, that our *Hypotheſis* does no way oblige us to deny, that there may be ſuch Stones. For though it aſcribes the Virtues of moſt Gems and Metalline Stones to the metalline and ponderous Mineral ſubſtances they partake of, yet the conceſſion agrees very well with our Doctrine; which, (as will in the Fourth Argument be more manifeſted) ſpeaks in general, when it teaches, that the Virtues of Stones may, in many caſes, depend upon their conſiſting not of a pure petreſcent ſubſtance, but a ſubſtance impregnated with other Minerals, which, though moſt commonly they prove ſpecifically heavier than the Petreſcent matter, as ſuch, without being the leſs, but rather in ſome caſes the more operative and communicative of their Virtues; yet in divers ſtony concretions, the adventitious ingredients may be ſpecifically lighter than the genuine matter of the Stone,

Stone; as may be eaſily gathered from ſome paſſages of the foregoing Diſcourſe. For, not here to urge, that divers Bodies, that paſs for Stones, do abound in particles of Salt, which may be much leſs heavy than pure Stone of the like bulk, I have obſerv'd, that ſome other hard Foſſils abound with a kind of *Bitumen*, which, when by diſtillation brought to an Oyl, is much leſs heavie than a Stone of the ſame bulk. And, as I remember, I have had ſome portions of ſuch Oil, that would ſwim even upon common water: and leſt this ſhould be aſcribed to the ſubtilization, the *Bitumen* received from the fire; I will add, that, having Hydroſtatically weighed a piece of good *Aſphaltum*, we found it to be to water of the ſame bulk, but as 1 and ſomewhat leſs than $\frac{4}{10}$ to 1. Which was within a Tenth of the proportion to water of a ſtony, though a bituminous, Foſſile, commonly call'd in *England* Scotch-Coal. And becauſe Sulphur as well as *Bitumen*, is very apt, (and indeed more apt than before tryal I expected)

by even a moderate heat or attrition to diffuse its steams, (usually ranck sented enough;) I shall add, that there are Variety of hard Stones, which abound in *Sulphur*: (witness that in some places they obtain their common *Brimstone* by sublimation thence) and yet having weigh'd a Role of Brimstone in Fire and Water, I found it to be but a fraction scarce worth mentioning above double its weight to the Liquor; which shews it to be much lighter *in specie* than Crystal it self.

An improvement of this first Answer may furnish me with the second. For hence we may argue, that 'tis not impossible, that the principal virtue of a light Medical Stone should be due to some mixture of a Metalline or the like ponderous substance; since, if some of the ingredients, that are plentifully mix'd with the true stony matter, be of the lighter sort, though there be also some Metalline or other heavie Mineral particles mingled with the same matter, yet the specific Levity of the one, in comparison of this matter, may compensate

penſate the ſpecific Gravity of the other, and they may all compoſe a Stone, either leſs, or not more, ponderous than white Marble. On which occaſion, I remember, not only that I found a blackiſh *Eaſt-Indian* Flint, and likewiſe a Black *Engliſh* one, to have to water not full the proportion of 2 $\frac{6}{10}$ to one, but that one of the firſt pieces of black Marble that I examin'd Hydroſtatically, was found, notwithſtanding the darkneſs of its colour, to be to water of the ſame bulk ſcarce any thing more than 2 $\frac{7}{10}$ to 1. which you may remember was the proportion I found between white Marble & water, unleſs we ſhould ſay, that this blackneſs of colour proceeded, not ſo much from any groſs Bituminous matter, imbodied with that of the Stone, but from ſome Mineral ſmoak that had pervaded it. And this puts me in mind of ſpeaking ſomething in this place about what might properly enough have been diſcourſed of long ago.

Wherefore I ſhall ſubjoin in the Third place, that it ſeems not impoſſible,

that the matter which Medical Stones are made of, may, before it comes to be hardened, derive various colours and be imbued with Virtues by subterraneal Exhalations and other steams. This I fear you will think somewhat strange, and therefore I shall briefly endeavour to confirm it by the mention of two or three particulars.

That then many places of the lower part of the Earth emit copious exhalations into the upper, and even into the Air it self; I presume you will grant, and I have elsewhere proved it. That also such subterraneal steams will easily mingle with Liquors, and imbue them with their own Qualities, may be inferr'd from the Experiment of mixing the *Gas*, (as the *Helmontians* call it) or the scarce coagulable fumes of kindled and extinquished Brimstone, with Wine, which is thereby long preserved. And I have elsewhere mentioned, how I have incorporated this Smoak with other Liquors, wherein I observed its operations o be notable.

That beneath the surface of the Earth

Earth there may be ſulphureous and other ſteams, that may be plentifully mix'd with water, and there in likelihood with Lapideſcent Liquors, I have alſo manifeſted in another * Dicourſe.

* *Of* Subterraneal *Steams.*

That Quick-ſilver may be in part reſolved into Fumes by leſs fires than many of thoſe that burn under ground, will be readily acknowledged by Chymiſts and Gilders, and is obvious in the Fumigations imployed in the Cure of the *Lues Venerea*. And that Mercury may in the bowels of the Earth be ſo diſguiſed, and well mixed with ſtony matter, as to ſuffer the whole concretion to paſs for Stone, may be obſerved in ſome kind of native Cinaber.

That Sal Armoniac, of which in ſome places there is to be dug up ſtore, will, with a moderate fire, be made to aſcend in form of exhalations, is vulgarly known, as to the factitious Salt of that name, and I have found it to hold in the native. That common Sal Armoniac, Sulphur, Mercury and Tin will be ſublimed into a Gold-like ſubſtance, that

participates of most, if not of all the Ingredients, may appear by the account I have elsewhere given of the way, I us'd in making *Aurum Musicum*: And that even Gold it self, the heaviest and fixest of the bodies we know, may by no great proportion of Additament, and that with but a moderate fire, be made to ascend in the form of Fumes or even of Flame, I have several times tryed, by wayes elsewhere deliver'd. And that Mineral Exhalations may be met with in the bowels of the Earth, is witnessed by the Relations of divers Credible persons, conversant about *Minerals*, that affirm themselves to testifie what they write upon their own Observation to which; some things that I had seen my self did the more incline me to give credit. And this copious ascension of Mineral fumes and even of Metalline ones, may be much confirmed not only by what is written by professed Chymists, but by the Learned and curious *Johannes Kentmannus*, who, in the useful Catalogue of the *Misnian* Fossils he had collected, amongst the *Pyritæ* or fire-

fire-ſtones, reckons one, whoſe title is *Pumicoſus, & ab exhalatione ardenti nigro colore tinctus*; and another, whoſe inſcription is *Coloris argenti, qui ab exhalatione viroſa colore cinereo eſt tinctus.* The ſame may be further confirmed by what I have ſome where met with as related *in terminis* by the Learned *Cabæus*, that he found in the Territory of *Modena.*

To bring this home to our purpoſe, ſince there are Mineral Exhalations of very differing kinds, diſperſed in divers places under ground, and ſince there are ſeveral volatile Minerals, as Arſenic, Orpiment, Sandarach, &c. that are very actively hurtful; there may be others indowed with Medicinal Qualities, and the Exhalations of ſuch Minerals either alone or mix'd with Petreſcent Liquors, pervading duly diſpoſed Earths and Boluſſes, and other fluid, ſoft, or open ſubſtances, before their induration, may endow them with Medicinal and other Qualities.

Nay, when I recall to mind the old *Phænomena* that I have partly obſerved, and partly received from credible teſtimony, about

about the coalitions, mixtures, tinctures, and the emanations, as 'twere, of those Tinctures, in metalline, stony, and other fossile concretions; I dare not peremptorily deny, but that, even after subterraneal bodies have obtained a considerable degree of induration, and perhaps great enough to make them pass for stony ones, there may be subterraneal steams subtle enough to penetrate, tinge, and otherwise impregnate them. Which you would think the less impossible, if you reflect upon what I just now related out of *Kentman*; and especially if I had time to add here, what I remember, I elsewhere deliver about my tryals to tinge native Crystal with differing colours by the fumes of volatile Minerals. And that a very small proportion of a Metalline substance, resolved into minute particles, may suffice to impart a tincture to a greater quantity of other matter duly disposed, may appear by those factitious Gems, wherein with three or four grains of a skilfully calcin'd Metal, or some such Mineral pigment, we may give the colour of a natural

natural Gem to a whole Ounce or more of vitrified matter. And I remember, that in ſubtiler fluids, I have made the inſtance by vaſt odds more conſpicuous, having ting'd with one grain or leſs of a prepared Metal (as Gold or Copper) as much ſucceſſively generated phlegm, as, if it could have been all preſerved, would have amounted to a bulky lump of deeply coloured matter.

But your allowing the heſitancy I have expreſſed in this laſt Paragraph, is not neceſſary to my preſent purpoſe; wherefore I ſhall not borrow any thing to countenance it from another Paper, but paſs on to what remains.

Arg. IV. The *laſt* thing, that I ſhall repreſent to ſhew, that the Virtues of opacous Gems and Medicinal ſtones may be more eaſily, than thoſe of tranſparent ones, accounted for in our *Hypotheſis*, is this, That the main Ingredients, whereof many ſuch opacous Stones conſiſt, were complete Mineral bodies before they became Stones; *ſome* of them having been Medicinal Boluſſes, or the like Earths; *ſome*, Earths abounding with

with Metalline or Mineral Juices; *ſome*, Ores of Metals, or Minerals of kin to, Metals; and *ſome*, *in fine*, Bodies of other ſorts or natures differing from theſe and one an other. For, all theſe ſeveral kinds of foſſils may, by the ſupervening and pervaſion of Petrific Spirits, be turn'd into Stone, and conſequently retain many of the Virtues, they were indowed with by the Mineral Corpuſcles, that had copiouſly, either under the form of Liquors, or Exhalations, impregnated them, whilſt they were yet Earths, or other bodies of a more open or Penetrable Texture.

I might illuſtrate this by the way I elſewhere mention, whereby I made ſuch mixtures even of Stony and Metalline Ingredients, that notwithſtanding their coalition were tranſparent, though you will grant that to be more difficult, than to compound ſuch concretions when one is allowed to make them opacous.

But here I muſt obviate an objection, which I foreſee may be made againſt our preſent Fourth Argument, unto which even what I have been now ſay-

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ing may afford a riſe. For ſince it ſeems by our Doctrine, that Gems may be but *Magiſteries*, and conſequently but ſuch compoſitions, as though made in the bowels of the Earth, might be made or imitated by humane skill, it may ſeem very improbable to many, that bodies ſo near of kin to Artificial ones, ſhould be endowed with ſuch peculiar and ſome of them with ſuch ſtrange Virtues as are aſcribed to divers Gems, and are thought to be capable of flowing only from certain Subſtantial forms and thoſe very noble ones too.

To this I might reply, that I admit not any ſuch imaginary Beings as the Peripatetic Forms, which I fear they will never be able to demonſtrate. But to avoid unneceſſary diſputes, I will rather anſwer in ſhort, that ſuch compoſitions as are call'd Artificial, may, for all that, be indowed with great Virtues, and ſuch as are call'd Specific; witneſs the Virtues of many Chymical Preparations, even of thoſe that are uſed by Phyſitians of all ſorts. And leſt you ſhould think, I need to fly to Chymiſtry

Chymistry, of which some Learned Men are pleased to have a great distast, I will name a couple of instances out of *Galen* himself; The one is the Ashes of Crafish, to which, notwithstanding the destruction that has been made of the pristine Body by fire, he gives a greater commendation against the, as strange, as fatal poyson infus'd by the biting of a mad Dog, than he does either to the Fish it self unburn'd, or to any medicine of Natures own providing; and I hope you will grant a Virtue of that kind and degree to be specific enough. My other Instance shall be taken from Treacle, which though allowedly a factitious body, and consisting of I know not how many Ingredients shuffled together, was yet in the dayes of *Galen* (to whom a Book is attributed about it) and ever since has been the famousest Antidote in these parts of the world, and has been celebrated not only for its Alexipharmacal Virtues, which alone are sufficient to intitle it to specific ones, but for divers others which are generally ascribed to it, some indeed

indeed upon the ſcore of Manifeſt, but others alſo upon that of Occult Qualities.

The objection being thus diſpatch'd, we may return to our Medicinal Stones, about which I ſhall venture to add, that according to our way of Explicating the production of them, a not impoſſible Solution may be offer'd of this difficult *Phænomenon*. That ſometimes Stones, that are thought without ſcruple to be of the ſame kind (as hath been particularly obſerved by Learned men of the *Lapis Nephriticus*) are of ſuch different qualifications, that ſome of them prove very conſiderable Remedies in caſes where others prove almoſt utterly ineffectual. And I have obſerv'd alſo, though very rarely, that a Medical Stone may have Virtues, that are taught to be the properties of Stones of another kind. For, according to our *Hypotheſis*, when the ſtony matter is impregnated as it ought to be with thoſe Minerals, that in the ordinary courſe of nature belong to that *ſpecies*, its

See *Unzerus de Nephrit.*

its Virtue will be ſuch as it ſhould be for kind, but for degree may be very various, anſwerable to the plenty, purity, ſubtlety, &c. of the Mineral that impregnates it. But if the ſtony matter chance to be inbued with ſome other ſubſtance of a contrary nature, though perhaps the proportion of it may be ſo ſmall, and the colour of it ſuch, as not to make an alteration in the Stone obvious to ſenſe, and great enough to make it judged to be of an other *ſpecies*; yet it may ſo vitiate the matter wherein its expected Quality reſides, or check and infringe its operations, as not to leave the Stone any conſiderable degree of Virtue. And on the other ſide, if it happen that the Mineral Corpuſcles, that are wont to impart a certain Virtue to the ſtony matter of one Gem, ſhould, by ſome lucky hit, be ſo united with that of an other ſort of Gems (of which caſe I formerly gave an Inſtance in green Diamonds,) though the quantity of this unuſual Ingredient may be but very ſmall, yet, if it's efficacy be great,

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it may innoble the Stone with a notable degree of ſome ſuch Virtue, as is ſuppoſed not to belong to that *Species*, but to an other.

And on this occaſion I ſhall add, that I know a Gentleman (a profeſſed Scholar) who to the Eye ſeems to be of a Complexion extraordinarily Sanguin: This perſon was for a long time ſo troubled with exceſſive bleedings at the Noſe, that, notwithſtanding all the Remedies he could procure in an Academy of Phyſick, where he lived, he was divers times brought to Death's door, till at length his Caſe growing very famous, there was ſent him by an antient Gentlewoman a Blood-ſtone, about the bigneſs of a Pigeons Egg, with an aſſurance that it had done ſcarce credible Cures in his Diſeaſe, by being worn about the Patients Neck. Upon the uſe of this Stone he quickly recovered his Health, and had long injoyed it when I convers'd with him, but yet ſo, that when he left it off any conſiderable time, his diſtemper would return. And when I ſeem'd to ſuſpect

that imagination might have an interest in the efficacy of this Remedy, he answer'd, that he was very well satisfied of the negative; and particularly upon this tryal, that he had, by the hands of a third person that liv'd not far off, and whom he nam'd to me, stop'd a Hæmorrogie in a neighbouring Gentlewoman, whom the violence of the Distemper kept from knowing that any thing had been applyed to her, till a pretty while after the Blood was stanched. I shall not here mention other Instances, though very remarkable, of the efficacy of this Stone, which I had both from the Gentleman himself, and an intimate Friend of his, who is a very Learned Man and a Physitian; because I have said enough to make it seasonable for me to tell you, that notwithstanding all the odd operations of this Stone, when I came to look upon it, 'twas so differing in Colour and Texture from what I expected, that I should have taken it much rather for a Gem of some other *species* than a Blood-stone.

To confirm some of the Particulars com-

comprized in this our Fourth Argument, and ſhew the variety and ſometimes great plenty of Mineral and other ſubterraneal matters, that may concur to the compoſition of Bodies that paſs for Stones; I ſhall obſerve, that the ſubtilty and penetrancy of ſome Liquors, if duly conſider'd, may evince it to be poſſible, that ſuch Bodies ſhould be petrified by them and with them, as may in part conſiſt of Animal and Vegetable ſubſtances, as in petrified Skulls, Bones, and pieces of wood: And we ſee, that ſoft Stone, which is plentifully found near *Naples*, and commonly call'd the *Lapis Lyncurius*, being rubb'd a little and moſtened with water, and then expos'd to the Sun in a due ſeaſon of the year, will, in a very ſhort time, (as Eye-witneſſes have aſſured me,) produce Muſhroms fit to be eaten; as if even the ſeminal Principles and Rudiments of Vegetables may be ſo preſerved in a petrified Earth, as to be able to diſcloſe themſelves when they find an opportunity. To which agrees well, what an eminent perſon,

Master of some of these Stones, informs me, *That they now and then find them of a vast bigness*; as if whole masses of Earth, pregnant with the prolific Principles of Mushroms, were by some supervening but not very potently hardening Petrescent Liquor, turn'd into Stone.

And not only there may be *Bolsuses*, seal'd Earths, and such like fossils, that are commonly known to be Medicinal, harden'd into Stone by petrifying Agents; but also other Earths, subject to be petrified, may have Medicinal and subtle particles of such a kind in them, as scarce any body would expect. But to omit Instances, belonging to another Paper, I have visited a certain Clay-pit in a wast piece of ground, in which at a considerable depth from the surface of the Earth there lay a bed of Clay, which by distillation yielded some acquaintances of mine a Salt so volatile and strong, and so differing from other subterraneal Salts, that my Examens did not discover the manifest qualities of it without some wonder; and the owners of it (persons curious

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and rich) did themſelves uſe it as well as give it in Phyſic, and cryed it up for an excellent Cordial, and a great opening and Diaphoretic Medicine.

That ſublimable Salts, Sulphurs, Bitumens, (Bodies that communicate enough of their Virtues,) may be met with in the bowels of the Earth; I have elſewhere ſhewn: And that ſuch ſubſtances may be found in bodies that paſs for Stones, I have been induced to think by the Chymical Examen, that I purpoſely made of ſome ſuch concretions, particularly of that ſolid and heavie one, that is commonly call'd *Scotch-Coal*, from whence I obtained by diſtillation, (wherein I ſomewhat wonder'd, other mens Curioſity did not, as far as I knew, prevent me;) a good proportion of Oil or liquid *Bitumen*, and no ſmall number of Saline particles, that ſeem'd to be of an uncommon nature.

That Metalline particles may concurr to make up a Body, that paſſes for a Medicinal Stone, may appear by native Sulphur which is it ſelf a compounded body, beſides a good

a good proportion of Mineral Earth.

I had thoughts not to make an end of this Diſcourſe, without mentioning to you ſome attempts, that I partly deſign'd, and partly made, to illuſtrate ſome paſſages of it by purpoſely contriv'd Experiments, whereof ſome were unproſperouſly and others not altogether unſucceſsfully try'd. But not having the Minutes of them by me, and not daring to truſt my ſingle memory in Experiments ſo nice, and ſo long ſince made, as thoſe were, I ſhall here put an end to your trouble, eſpecially ſince at length I perceive, that the forgetfulneſs of my firſt intended brevity has miſled me ſo far beyond the bounds of it into Excurſions, whereinto the unforeſeen connexion of things unawar's engag'd me, that I ſtand in need both of your pardon and my own: Of *your's*, for having exercis'd your Patience with a prolix Diſcourſe; and of *my own*, for having receded from my Cuſtome, by contributing to that prolixity, and by expatiating upon Conjectures; to which, the more I conform

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to my own Practiſe, the leſs I am indulgent: Though theſe may be the more pardonable, becauſe I have propoſed them but as Gueſſes, not peremptory Aſſertions, much leſs Phyſical Demonſtrations. And if *Ariſtotle* himſelf, where he gives an account of *Phænomena* appearing above the ſurface of the Earth, ſcrupled not to think, he had done enough, if he had ſhewn, how ſuch things *may be* produc'd; I hope, it may be tolerable in me, who treat of things, that Nature does privately in her dark and ſubterraneal Receſſes, to have offer'd Accounts, that are poſſible, if not probable. And yet I ſhould have ſpent much leſs of my Diſcourſe upon Conjectures, if I had not ſeen, that they gave me Riſes to bring in more of Natural Hiſtory, than I could elſe decently do. But after all this I confeſs to you, (though you may think it a Paradox) that one of the main cauſes of the Prolixity of theſe Papers was my Haſt, and that Experience hath taught me, on this Occaſion (as well as on ſome others) that

that there may be more Truth than there is Likelihood in the gentile Conceipt of a *French Secretary*, that ſaid, He had written his Friend a long Letter, becauſe he had not Leiſure to write him a ſhort One.

FINIS.